AECOM

City of Winnipeg

Construction of North Garage Replacement

Issued for Tender Submission
Tender No. 593-2024B

Date: February 28, 2025

PROJECT MANUAL

Division 01 to 41

Construction Documents consist of modified Specifications and Drawings and include a compilation of changes made to the Bid Documents arising from Addenda, Bid Revisions, and other Negotiated Changes (if any). Construction Documents are substantially consistent with the Contract Documents, which consist of the original Bid Documents, Addenda and Bid Revisions. Contract Documents will be used for interpretation where any differences between Construction Documents and Contract Documents occur.

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1 General

1.1 GENERAL CONDITIONS

1. Work of this Contract comprises of new construction of project description as outlined in the Contract Documents.
2. Division of the Work among Subcontractor’s suppliers or vendors is solely the Contractors responsibility. Contract Administrator assumes any responsibility to act as an arbiter to establish subcontract terms between sectors or disciplines of work.

1.2 DESCRIPTION OF WORK

1. Work of this Contract comprises of new construction of project description as outlined in the Contract Documents.
2. Division of the Work among Subcontractor’s suppliers or vendors is solely the Contractors responsibility. Contract Administrator assumes any responsibility to act as an arbiter to establish subcontract terms between sectors or disciplines of work.

1.3 THE CONTRACT DOCUMENTS

1. Division 1 General Requirements, of the Specification generally specify work and coordination of the work that is the direct responsibility of the Contractor but shall not be interpreted to define absolutely the limits of responsibility that must be established between the Contractor and his Subcontractors by their separate agreements.
2. Ensure that Subcontractors understand that the General Conditions of the Contract, and Division 1 General Requirements, apply to Sections of the Specification governing their work.
3. Ensure that the work includes all labour, equipment and products required, necessary or normally recognized as necessary for the proper and complete execution of the work of each trade.
4. Work in this Specification is divided into descriptive Sections which are not intended to identify absolute contractual limits between Subcontractor, nor between the Contractor and its Subcontractors. The Contractor shall organize division of labour and supply of materials essential to complete the Project in all its parts and provide a total enclosure and protection from weather of interior spaces, as established in the General Conditions of the Contract.
5. As a result, the Contract Administrator shall not be required to decide on questions arising with regard to agreements or contracts between the Contractor and Subcontractors or Suppliers, nor to the extent of the parts of the Work assigned thereto.
6. Further, no extra will be allowed as a result of the failure to coordinate and allocate the Work such that the Work is Provided in accordance with the Contract Documents.
7. Wherever the word "building" occurs in the Contract Documents it shall be taken to mean all the buildings included in the Contract.
8. Wherever in the Contract Documents the words "approval", "approved", "direction", "directed", "selection", "selected", "request", "requested", "report", and similar words are used, such approvals, directions, selections, requests, and reports shall be given by the Contract Administrator in writing unless specifically stated otherwise.
9. Whenever in the Specifications the term "and/or" is used, the Contract Administrator shall decide which of the possible meanings, to be derived at from the sentence where this term occurs shall govern.

1.4 DIVISION 1 – GENERAL REQUIREMENTS

1. The provisions of all Sections of Division 01 shall apply to each Section of this Specification.

1.5 STANDARDS AND CODES

1. Contract forms, codes, specifications, standards, manuals and installation, application and maintenance instructions referred to in these specifications, unless otherwise specified, amended or date suffixed, shall be latest published editions at Contract date.

1.6 LAWS, NOTICES, PERMITS AND FEES

1. Comply with codes, by-laws, and regulations of authorities having jurisdiction over the Place of the Work. Codes and regulations form an integral part of the Contract Documents.
2. Permits:
    1. The Contractor shall obtain and pay for all permits, licenses, deposits and certificates of inspection as part of the Work, including permits for road closures except for clause 1.6.2.2 of this Section.
    2. Contract Administrator has initiated the permit application process for the following, but responsibility for completing the application process with the Contractor:
        .1 Contract Administrator has initiated the Development Permit and Commercial Building Permit with the City's Planning, Property and Development Department.
        .2 The City through the Contract Administration will pay for the Development Permit and Commercial Building Permit. Reimbursement of the cost for the Development Permit and Commercial Building Permit to the Contractor will not be required.
        .3 The Development Permit and Commercial Building Permit will be transferred to the Contractor for Contractor usage. The Contractor will be named on the permits as applicable.
    2. Obtain permits required to execute work on City Rights-of-Way. Obtain damage deposits for sidewalks, roads, and services, unless otherwise indicated.
    3. Arrange for inspection, testing and acceptance of the Work required by the authorities having jurisdiction. Be responsible for necessary preparations, provisions and pay costs.
    4. It is the responsibility of the Contractor to schedule notifications and inspections required by authorities having jurisdiction such that notifications can be properly received and that inspections can be properly undertaken without causing a delay in the Work. The Contractor, at no additional cost, shall be solely responsible for any delay in the Work caused by failure to properly schedule required notifications and inspections.

1.7 DISCREPANCIES AND CLARIFICATIONS

1. Advise Contract Administrator of discrepancies discovered in requirements of the Contract Documents and request clarification from Contract Administrator in written form.
2. Advise Contract Administrator when clarifications are required pertaining to meaning or intent of requirements of Contract Documents and request clarification from Contract Administrator in written form.
3. Do not proceed with related work until written clarification is provided by Contract Administrator.

4. Failure to notify Contract Administrator shall result in Contractor incurring responsibility for resulting deficiencies and expense at no additional cost to the Contract.

5. Written instructions issued by Contract Administrator for the purpose of clarification, implicitly supersede applicable and relevant aspects of the Contract Documents irrespective of whether or not these documents are explicitly or specifically cited in clarification requests or clarification instructions.

1.8 WORK BY CONTRACT ADMINISTRATOR

1. Permit the Contract Administrator and/or their subconsultants to inspect the work at any reasonable time, and to perform such work and install such equipment as the Contract Administrator may require.

1.9 SITE PROGRESS RECORDS

1. Maintain at site a permanent written record of progress of work. Make the record available at all times with copies provided when requested. Include in record each day:
    1. Weather conditions with maximum and minimum temperatures.
    2. Conditions encountered during excavation. Record quantities pumped for dewatering.
    3. Commencement and completion dates of the work of each trade in each area of Project.
    4. Record of all Civil above and below grades quantities.
    5. Erection and removal dates of formwork in each area of Project.
    6. Dates, quantities, and particulars of each concrete pour.
    7. Dates, quantities, and particulars of waterproofing installation.
    8. Dates, quantities, and particulars of air and vapour barrier installation.
    9. Dates, quantities, and particulars of roofing installation.
    10. Attendance of Contractor's and Subcontractor's work forces at Project and a record of the work they perform.
    11. Dates, status, and particulars of submissions, i.e., shop drawings, samples, mock-ups and the like.
    12. Dates, status, and particulars of deliveries, i.e., manufacturing dates, delivery, and installation dates.
    13. Visits to site by Contract Administrator, authorities having jurisdiction, testing companies, Contractor, Subcontractors, and suppliers.
2. Maintain a progress chart in approved format. Show on chart proposed work schedule and progress of work by Contractor and Subcontractor. The status of delivery items, i.e., shop drawings status, manufacture dates - delivery and installation dates.

1.10 DOCUMENTS AT THE PLACE OF THE WORK

1. Maintain at the Place of the Work, one copy of each of following:
    1. Contract Documents including drawings, specifications, addenda, and other modifications to the Contract, including copies of standards and codes referenced in the Contract Documents.
    2. 'Reviewed' or 'Reviewed as Modified' shop drawings. Refer to Section 01 33 00 – Submittal Procedures for details of schedules required.
    3. Construction, inspection and testing, and submittal schedules.

4. Supplemental Instructions, proposed contract change, Change Orders, and Change Directives.
5. Field Test Reports.
6. Contract Administrator's field review reports and deficiency reports.
7. Reports by authorities having jurisdiction.
8. Building and other applicable permits, and related permit documents.
9. Daily log of the Work.
10. As-built drawings recording as-built conditions, instructions, changes, and the like, as called for in Section 01 78 00 – Closeout Submittal, prior to being concealed.

2. Make above material available to Contract Administrator upon request.

1.11 TRADEMARK AND LABELS

1. Trademarks and labels, including applied labels, shall not be visible in finished work in finished areas, unless otherwise accepted or indicated by Contract Administrator.

1.12 SITE LAYOUT AND SURVEY CONTROL

1. The Contractor shall obtain the services of a Manitoba Land Surveyor (Contractor's Land Surveyor) to provide property pins and On-Site layout. Submit land survey in accordance with Section 01 33 00 – Submittal Procedures. Submit the land survey submittal prior to the construction activity commencing On-Site.
2. Contractor's Land Surveyor shall supply and install fixed datum point On-Site for survey control.
3. The Contractor shall provide protection around the installed datum point at all times.
4. The fixed datum point shall be accessible to the Contractor Administrator at all times.
5. Contractor's Land Surveyor shall provide the building layout and related reference points On-Site for the Contractor's survey staff to utilize.
6. Contractor's survey staff shall have minimum 5 years experience working for the similar size and type of projects similar to this Contract.
    1. Submit letter to prove Contractor's survey staff experience in accordance to Section 01 33 00 – Submittal Procedures.
7. Construction Measurements:
    1. Take site dimensions of completed work before installation of work to be incorporated commences.
    2. Before commencing installation of work, verify that its layout is accurately in accordance with intent of Drawings, and that positions, levels, and clearances to adjacent work are maintained.
    3. Before commencing work, verify that all clearances required by authorities having jurisdiction can be maintained.
    4. If work is installed in wrong location, rectify it before construction continues.
    5. Where dimensions are not available before fabrication commences, the dimensions required shall be agreed upon between the trades concerned.
    6. All measurements shall be metric.

1.13 PROTECTION OF WORK, PROPERTY AND PERSONS

1. Include in work necessary methods, materials, and construction to ensure that no damage or harm to work, materials, property and persons results from the work of this Contract. Temporary facilities relating to protection are specified in Section 01 50 00 – Temporary Facilities and Controls.
2. Comply with all instructions and/or orders issued by authorities having jurisdiction.
3. Ensure that compulsory wearing of hard hats and safety boots is observed by all persons employed on the work. Provide spare hard hats for visitors, refuse admission to the premises to those refusing to wear same.
4. Keep excavations, and pits free of rainwater, ground water, backing up of drains and sewers, and all other water. Pump dry as required.
5. Protect adjacent private and public property from damage and, if damaged, make good immediately. Make good private property to match in all details its original condition in material and finishes as approved, and public property in accordance with requirements specified and as directed by the Contract Administrator.
6. Keep surfaces, on which finish materials will be applied, free from grease, oil, and other contamination which would be detrimental in any way to the application of finish materials.
7. Do not apply visible markings to surfaces exposed to view in finished state or that receive transparent finishes.
8. Protect surfaces of completed work exposed to view from staining, disfigurement and all other damage by restriction of access or by use of physical means suitable to the material and surface location. Establish with each Subcontractor the suitability of such protection in each case.
9. Brace and shore masonry walls until their designed lateral support is incorporated at both top and bottom, in accordance with safe construction practices.
10. Enforce fire prevention methods at site for new work maintain existing in accordance with local authorities having jurisdiction. Do not permit bonfires, open flame heating devices or accumulation of debris. Use flammable materials only if proper safety precautions are taken, both in use and storage.
11. Do not store flammable materials in the building. Take necessary measures to prevent spontaneous combustion. Place cloths and other disposable materials that are a fire hazard in closed metal containers and remove them from the building every night.
12. Where flammable materials are being applied, ensure that adequate ventilation is provided, spark-proof equipment is used, and smoking and open flames are prohibited.
13. Ensure that volatile fluid wastes are not disposed of in storm or sanitary sewers or in open drain courses.
14. Preform spill response in accordance with procedures outlined by authority having jurisdiction, and upon request by City, provide detailed spill response procedures report for review.
15. Public Utilities and Services:

1. Verify location of and limitations imposed by, existing mechanical, electrical, telephone and similar services, and protect them from damage. If necessary, relocate active services to ensure that they function continuously wherever possible in safety and without risk of damage or down time to the existing buildings.

2. Cap off and remove unused utility services encountered during work after approval is given by the utilities concerned or authorities having jurisdiction, which ever may apply. Relocation, removal, protection and capping of existing utility services shall be performed only by the applicable utility, and of other services by licensed mechanics.

3. Make arrangements and pay for connection charges for services required for the Work.

16. Ensure that precautions are taken to prevent leakage and spillage from plumbing and mechanical work that may damage surfaces and materials finished or unfinished.

17. Give constant close supervision to roofing, waterproofing air and vapour barrier membranes following their installation, during the time they are temporarily protected or exposed, to ensure that no damage occurs to them before completion of building.

18. Prevent spread of dust beyond the construction site by wetting, or by other approved means, as required or as directed by the Contract Administrator and/or authorities having jurisdiction.

19. Make good roads, soft landscaping, walkways, curbs, sidewalks, possessions and property, soiled or damaged due to the Work, to requirements of authorities having jurisdiction and requirements of and making good, as applicable.

1.14 WORK ON PUBLIC PROPERTY

1. Include curb cuts and making good of existing property to Provide fully paved and finished approaches to requirements of authorities having jurisdiction.

2. Include making good of existing curbs, walks, paving and soft landscaping on adjacent property.

1.15 INSERTS, ANCHORS AND FASTENINGS

1. Include in the work of each Section necessary fastenings, anchors, inserts, attachment accessories, and adhesives. Where installation of devices is in work of other Sections, deliver devices in ample time for installation, locate devices for other Sections and co-operate with other Sections as they require.

2. Do not install wood plugs or blocking for fastenings in masonry, concrete, or metal construction, unless specified or indicated on the drawings.

3. Do not use fastenings which cause spalling or cracking of materials in which they are installed. Do not use powder actuated fastening devices unless specified or prior written approval is given by the Contract Administrator for each specific use.

4. Use only approved driven fasteners.

5. Install metal-to-metal fastenings fabricated of the same metal or of a metal which will not set up electrolytic action causing damage to fastenings or components, or both. Use non-corrosive or galvanized steel fastenings for exterior work, and where attached to, or contained within, exterior walls and slabs. Leave steel anchors bare where cast in concrete.

6. Install work with fastenings or adhesives in sufficient quantity to ensure permanent secure anchorage of materials, components, and equipment. Space anchors within limits of loadbearing or shear capacity.

7. Space exposed fastenings evenly and in an organized pattern. Keep number to a minimum. Provide exposed metal fastenings of same material, texture, colour, and finish as metal on which they occur.

8. At fastenings that penetrate metal roof deck, ensure that penetrations are sealed airtight with approved sealant.

9. Galvanize steel anchors in masonry and at exterior of building, unless otherwise specified elsewhere. Leave steel anchors bare where cast in concrete.

1.16 CLEANING

1. Ensure that spatters, droppings, soil, labels, and debris are removed from surfaces to receive finishes before they set up. Leave work and adjacent finished work in new condition.
2. Use only cleaning materials which are recommended for the intended purpose by both the manufacturer of the surface to be cleaned and by the cleaning material supplier.
3. Maintain areas "broom clean" at all times during the work. Vacuum clean interior areas immediately before finish painting commences.
4. Do not burn or bury waste material at site. Remove as often as required to avoid accumulation.
5. Do not allow waste material and debris to accumulate in an unsightly or hazardous manner. Sprinkle dusty accumulations with water or other approved materials during removal of same.
6. Control lowering of materials. Use as few handlings as possible. Do not drop or throw materials from storeys above grade.
7. Ensure that cleaning operations are scheduled to avoid deposit of dust or other foreign matter or surfaces during finishing work and until wet or tacky surfaces are cured.
8. Each Section shall supply the Contractor with instructions for final cleaning of his work, and for inclusion in Project Data Book as specified in each trade Section and in Section 01 74 00 – Cleaning and Waste Processing.
9. Final cleaning is to be performed one (1) week prior to opening the project to the public and shall include cleaning of all work as required by each trade. Co-ordinate final cleaning with City's maintenance staff.

1.17 ADJUSTING

1. Ensure that all parts of work fit snugly, accurately and in true planes, and that moving parts operate positively and freely, without binding and scraping.
2. Verify that work functions properly and adjust it accordingly to ensure satisfactory operation.
3. Lubricate products as recommended by the supplier.

1.18 SALVAGE

1. Unless otherwise specified, surplus material resulting from construction, and construction debris shall become the property of Contractor, who shall dispose of it away from site.

2 Products

NOT USED

3 Execution

NOT USED

END OF SECTION

1 General

1.1 EXISTING SERVICES

.1 Notify the City and utility companies of intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services, give the City a minimum of 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum.

.3 Provide for pedestrian and vehicular traffic in accordance with City of Winnipeg Standard Construction Specifications.

.4 Construct barriers in accordance with Section 01 56 00 – Temporary Barriers and Enclosures.

1.2 SPECIAL REQUIREMENTS

.1 Restrictions for work involving major noise emitting activities shall be in accordance with the requirements of authorities having jurisdiction.

.1 Major noise emitting activities shall include activities that generate noise levels above those normally generated by construction activities, such as pile driving, demolition, and the like.

.2 Notify the City and representatives of occupied buildings adjacent to the Place of the Work, as well as the Contract Administrator and the City, a minimum of 48 hours prior to undertaking major noise emitting activities, including a description of the nature and extent of such activities. The City shall provide contact information for representatives of adjacent occupied buildings to the Contractor.

.3 Installation of hoarding shall be coordinated with the City.

.4 Required relocation of hoarding during construction shall be coordinate with the City.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

1 General

1.1 DEFINITIONS

.1 Alternate Prices.

.1 Alternate Price: a price required by this Section, to be added or deducted from the Stipulated Price (Bid Price) for the specified alternate work. Include all costs for co-ordination of the related work and modify surrounding work as required to complete the project under each alternate.

1.2 ALTERNATE PRICIES

.1 Alternate Price No. 1.

.1 Base Bid Price: Pave the parking lot as indicated in the contract documents.

.2 Alternate Price: Delete the installation of asphalt paving, supply and install gravel.

.2 Alternate Price No. 2.

.1 Base Bid Price: Supply and install both bus washes (external & undercarriage) as indicated in the contract documents.

.2 Alternate Price: Defer the supply and install of one bus wash (external & undercarriage). All preparation and utility rough-ins to be completed.

.3 Alternate Price No. 3.

.1 Base Bid Price: Supply and install the interior building furniture as indicated in the contract documents.

.2 Alternate Price: Delete the supply and install the interior building furniture.

.4 Alternate Price No. 4.

.1 Base Bid Price: Supply and install the site fencing as indicated in the contract documents.

.2 Alternate Price: Delete the supply and install the site fencing as indicated in the contract documents.

.5 Alternate Price No. 5.

.1 Base Bid Price: Construct the Bus Storage-Compartment 03 as indicated in the contract documents.

.2 Alternate Price: Reduce the Bus Storage-Compartment 03 by one half.

.6 Alternate Price No. 6.

.1 Base Bid Price: Construct the Bus Storage-Compartment 03 as indicated in the contract documents.

.2 Alternate Price: Reduce the remaining half of Bus Storage-Compartment 03 (this will defer construction of the full Bus Storage-Compartment 03).

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

1 General

1.1 REQUEST FOR INTERPRETATION - RFI

.1 A request for interpretation (RFI) is a formal process used during the Work to obtain an interpretation of the Contract Documents.

.2 Submittal procedures:

.1 RFI form:

.1 Submit RFI on "Request for Interpretation" form, appended to this section. The Contract Administrator shall not respond to an RFI except as submitted on this form.

.2 Where RFI form does not provide sufficient space for complete information to be provided thereon, attach additional sheets as required.

.3 Submit with RFI form necessary supporting documentation.

.2 RFI log:

.1 Maintain log of RFIs sent to and responses received from the Contract Administrator, complete with corresponding dates.

.2 Submit updated log of RFIs with each progress draw submittal.

.3 Submit RFIs sufficiently in advance of affected parts of the Work so as not to cause delay in the performance of the Work. Costs resulting from failure to do this will not be paid by the City.

.4 RFIs shall be submitted only to the Contract Administrator.

.5 RFIs shall be submitted only by Contractor. RFIs submitted by Subcontractors or Suppliers shall not be accepted.

.6 Number RFIs consecutively in one sequence in order submitted.

.7 Submit one distinct RFI per RFI form.

.8 Contract Administrator shall review RFIs from the Contractor submitted in accordance with this section, with the following understandings:

.1 Contract Administrator's response shall not be considered as a Change Order or Change Directive, nor does it authorize changes in the Contract Price or Contract Time or changes in the Work.

.2 Only the Contract Administrator shall respond to RFIs. Responses to RFIs received from entities other than the Contract Administrator shall not be considered.

.9 Allow ten (10) Working Days for review of each RFI by the Contract Administrator.

.1 Contract Administrator's review of RFI commences on date of receipt by the Contract Administrator of RFI submittal and extends to date RFI returned by Contract Administrator.

.2 When the RFI submittal is received by Contract Administrator before noon, review period commences that day; when RFI submittal is received by Contract Administrator after noon, review period begins on the next Working Day.

.10 Contractor shall satisfy itself that an RFI is warranted by undertaking a thorough review of the Contract Documents to determine that the claim, dispute, or other matters in question relating to the performance of the Work or the interpretation of the Contract Documents cannot be resolved by direct reference to the Contract Documents. Contractor shall describe in detail this review on the RFI form as part of the RFI submission. RFI submittals that lack such detailed review description, or where the detail provided is, in

the opinion of the Contract Administrator, insufficient, shall not be reviewed by the Contract Administrator and shall be rejected.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

Contractor's Requests for Interpretation

Date	**No. of Pages**
To	**From**
Co.	**Co.**
Phone #	**Phone #**
Fax #	**Fax #**

Project: 593-2024B Construction of North Garage Replacement

RFI No.:

Owner: City of Winnipeg

Date of Request:

To: (Contract Administrator)

Contractor:

Project No.:

Contractor's Representative:

Reference Specifcation Section:

Reference Drawing Number:

Interpretation Requested: (Description of request for interpretation and references to relevant portions of Contract Documents)

Attachements:

Requested by:

Contract Administrator's Instruction:

Attachements:

Reply by:

The work shall be carried out in accordance with these Supplemental Instructions issued in accordance with the Contract Documents without change in Contract Price or Contract Time. Prior to proceeding with these instructions, indicate accemptance of these instructions as being consistent with the Contract Documents by returning a signed copy to the Contract Administrator.

Issued:

By:
Contract Administrator **Date**

Accepted:

By:
Contractor **Date**

Cc: ☐ **Owner** ☐ **Contract Administrator** ☐ **Contractor** ☐ **Field** ☐ **Other:**

1 General

1.1 DESCRIPTION

.1 Summary:

.1 Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

.2 See General Conditions C12.

1.2 SCHEDULE OF VALUES

.1 Provide Schedule of Values with submission of monthly progress estimates.

.2 Schedule of Values to be supported by evidence as Contract Administrator may reasonably direct and, when accepted by Contract Administrator, to be used as basis for progress estimates.

1.3 MEASUREMENT AND PAYMENT

.1 No payment(s) will be made prior to the completion of Contract execution by both parties and all requisite bonds and insurance have been submitted and approved.

.2 For each lump sum price item, the Contract Administrator will calculate payment based upon the Bid lump sum price for each item in the Form B: Prices and the Contract Administrator's estimate of the percentage of Work completed for each item.

1.4 ITEMS COVERED BY CONTRACT PRICES

.1 In addition to covering the cost of various items of the Work, the Contract lump sum price shall cover the cost of furnishing all materials, tools, equipment, labour, services transportation, and incidentals necessary for executing the Work. Any item of work not specifically listed under Contract unit or lump sum prices shall be considered incidental to such other items as are listed. Payment for work performed under the various Divisions of the Contract shall be made at the respective lump sum price breakdown for that item.

.2 Payment for work performed under the various Divisions of the Contract shall be made at the respective lump sum price breakdown for that item.

.3 Insurance and bonding shall be considered incidental to the Work. There shall be no separate payment for these items.

1.5 PAYMENT

.1 Reference City of Winnipeg, General Conditions for Construction C12.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

1 General

1.1 DESCRIPTION

.1 Coordination of the work of all Sections of the Specification is the responsibility of the Contractor.

.2 The Contractor will be deemed to possess the necessary technical skills to carefully evaluate all requirements of the Contract, and to have included in the Price all costs for the proper implementation of these requirements.

.3 The Contractor's responsibility includes, but is not restricted to, co-ordination specified in this Section, except where otherwise specified.

1.2 RELATED MECHANICAL AND ELECTRICAL WORK

.1 Coordination of the installation of systems specified in Divisions 20 and 28, including the interrelating operation and functioning between components of a system and between systems, is the responsibility of those performing the work of Divisions 20 and 28, with final coordination the responsibility of the Contractor.

.2 Provide interference drawings as herein specified to ensure proper co-ordination of subtrade work. No extras will be considered for work not properly coordinated prior to installation.

.3 Ensure that service poles, pipes, conduit, wires, fill-pipes, vents, regulators, meters and similar Project service work is located in inconspicuous locations. If not indicated on Drawings, verify location of service work with Contract Administrator before commencing installation.

1.3 QUALITY ASSURANCE

.1 Requirements of Regulatory Agencies:

.1 Coordinate requirements of authorities having jurisdiction.

.2 Quality Control:

.1 Ensure that work meets specified requirements.

.2 Schedule, supervise and coordinate inspection and testing as specified in Section 01 40 00 – Quality Requirements.

.3 Job Records:

.1 Maintain job records and ensure that such records are maintained by Subcontractors.

1.4 SUPERINTENDENCE

.1 Provide superintendent and necessary supporting staff personnel who shall be in attendance at the Place of the Work while Work is being performed, with proven experience in erecting, supervising, testing and adjusting projects of comparable nature and complexity.

.2 The Contractor shall appoint a superintendent at the Place of the Work who shall have overall authority at the Place of the Work and shall speak for the Contractor and represent the Contractor’s interest and responsibilities at meetings at the Place of the Work and in dealings with the Contract Administrator and the City.

.3 Supervise, direct, manage and control the work of all forces carrying out the Work, including subcontractors and suppliers. Carry out daily inspections to ensure compliance with the Contract Documents and the maintenance of quality standards. Ensure that the supervisory staff includes personnel competent in supervising all Sections of Work required.

.4 Arrange for sufficient number of qualified assistants to the supervisor as required for the proper and efficient execution of the Work.

.5 Superintendent shall be accessible to the Contract Administrator by cellular communication during normal working hours.

1.5 COORDINATION OF SUBMITTALS

.1 Provide a complete set of all required Contract Documents, together with instructions for changes to the work which are issued, to each firm preparing shop drawings.

.2 Schedule and expedite submission of specified submittals.

.3 Review submittals and make comments as specified in Section 01 33 00 – Submittal Procedures.

.4 Ensure that each original submission, and their subsequent revisions and resubmissions are made on schedule.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 It is the responsibility of the Contractor to ensure that the supplier or distributor of materials specified or accepted alternatives, which have been bid, has materials on the site when required. The Contractor shall obtain confirmed delivery dates from the supplier, and ensure no delay in the progress of the work

.2 Provide equipment delivery schedule, coordinated with construction and submittals schedule, showing delivery dates for major and/or critical equipment. Provide delivery access and unloading areas.

.3 Make available areas for storage of products and construction equipment to meet specified requirements, and to ensure a minimum of interference with progress of the work and relocation.

.4 Make access available for transference of stored products and construction equipment to work areas.

.5 The Contractor shall contact the Contract Administrator immediately upon receipt of information indicating that any material or item, will not be available on time, in accordance with the original schedule, and similarly it shall be the responsibility of all subcontractors and suppliers to so inform the Contractor.

.6 The Contract Administrator reserves the right to receive from the Contractor at any time, upon request, copies of actual purchase or work orders of any material or products to be supplied for the work.

.7 If materials and products have not been placed on order, the Contract Administrator may instruct such items to be placed on order, if direct communication in writing from the manufacturer or prime suppliers is not available indicating that delivery of said material will be made in sufficient time for the orderly completion of the Work.

.8 The Contract Administrator's review of purchase orders or other related documentation shall in no way release the Contractor, or his subcontractors and suppliers from their responsibility for ensuring the timely ordering of all materials and items required, including the necessary expediting, to complete the work as scheduled in accordance with the Contract Documents.

1.7 JOB CONDITIONS

.1 Ensure that conditions within the building are maintained and that work proceeds under conditions meeting specified environmental requirements.

.2 Ensure that protection of adjacent property and the work is adequately provided and maintained to meet specified requirements.

1.8 CO-ORDINATION

.1 Review Contract Documents and advise the Contract Administrator of possible conflicts between parts of the work before preparation of shop drawings, ordering of products or commencement of affected work.

.2 Coordinate and be responsible for layout of all work in each area and work on which subsequent work depends to facilitate mutual progress, and to prevent conflict between parts of the work.

.3 Ensure that each Section makes known, for the information of the Contractor and other Sections, the environmental and surface conditions required for the execution of its work; and that each Section makes known the sequences of others' work required for installation of its work.

.4 Ensure that each Section, before commencing work, knows requirements for subsequent work and that each Section is assisted in the execution of its preparatory work by Sections whose work depends upon it.

.5 Ensure that work to be enclosed within ceiling and wall spaces can be accommodated without interference and with other parts of the work.

.6 Ensure that setting drawings, templates, and all other information necessary for the location and installation of materials, holes, sleeves, inserts, anchors, accessories, fastenings, connections, and access panels are provided by each Section whose work requires cooperative location and installation by other Sections, and that such information is communicated to the applicable installer.

.7 Deliver materials supplied by one Section to be installed by another well before the installation begins, as per Construction Progress Schedule.

.8 Sections giving installation information in error, or too late to incorporate in the work, shall be responsible for having additional work done which is thereby made necessary.

.9 Remove and replace work installed in error which is unsatisfactory for subsequent work.

.10 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the spaces provided.

.11 Prepare drawings to indicate coordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, and connections are coordinated.

.12 Ensure that clearance required by authorities having jurisdiction and for proper maintenance are indicated on Drawings.

.13 Distribute coordination drawings well in advance of fabrication and installation of work affected. Place no orders for affected equipment without submission of coordination drawings to the supplier.

1.9 COOPERATION

.1 Provide forms, templates, anchors, sleeves, inserts and accessories required to be fixed to or inserted in the Work and set in place or instruct separate Subcontractors as to their location.

.2 Supply items to be built in, as and when required together with templates, measurements, shop drawings and other related information and assistance.

.3 Pay the cost of extra work and make up time lost as a result of failure to provide necessary information and items to be built in.

1.10 PROJECT RECORD DRAWINGS

.1 Record, as the work progresses, work constructed differently than shown on Contract Documents. Record all changes in the work caused by site conditions; by the City, Contract Administrator, sub-consultants, Contractor, and Subcontractor originated changes; and by site instructions, supplementary instructions, field orders, change orders, addendums, correspondence, and directions of authorities having jurisdiction.

Accurately record location of concealed structure, and mechanical and electrical services, piping, valves, conduits, pull boxes, junction boxes and similar work not clearly in view, the position of which is required for maintenance, alteration work, and future additions. Do not conceal critical work until its location has been recorded.

.2 Dimension location of concealed work in reference to building walls, and elevation in reference to floor elevation. Indicate at which point dimension is taken to concealed work. Dimension all terminations and offsets of runs of concealed work.

.3 Make records in a neat and legibly printed manner with a non-smudging medium.

.4 Identify each record drawing as "Project Record Copy". Maintain drawings in good condition and do not use them for construction purposes.

.5 After completion of the work, purchase a complete set of white prints from the Contract Administrator and transfer the information recorded on the white prints accurately, neatly in red ink with dimensions, as applicable. Return these marked-up as-built white prints plus two additional sets of white prints to the Contract Administrator for his review. Any subsequent changes found by the Contract Administrator shall remain the responsibility of the contractor and new white prints will be issued for these changes and re-submitted back to the Contract Administrator at no charge to the City.

.6 Maintain Project record drawings in a state current to Project. Such state will be considered a condition precedent for validation of applications for payment. The Contract Administrator's visual inspection will constitute proof that record drawings are current.

.7 Provide Contract Administrator with accurate red-marked record drawings for their transfer to latest version of AutoCad with application for Certificate of Substantial Performance. Final acceptance of the Work will be predicated on receipt and approval of record drawings.

1.11 CUTTING AND PATCHING

.1 Before cutting, drilling, or sleeving structural load-bearing elements, obtain approval of location and methods from the Contract Administrator.

.2 Do not endanger work or property by cutting, digging, or similar activities. No Section shall cut or alter the work of another Section unless such cutting or alteration is approved by the latter Section and the Contractor.

.3 Cut and drill with true smooth edges and to minimum suitable tolerances.

.4 Fit construction tightly to ducts, pipes and conduits to stop air movement completely. The Section performing work that penetrates a fire, air, vapour, moisture, thermal or acoustic separation of the building shall pack voids tightly with rock wool, fibreglass or fire stop material as may be required; seal air, vapour and moisture barriers; and caulk joints as may be required to ensure that no air movement through the penetration is possible.

.5 Cutting, drilling and sleeving of work shall be done only by the Section who has installed it. The Section requiring drilling and sleeving shall inform the Section performing the work of the location and other requirements for drilling and sleeving.

.6 Replace, and otherwise make good, all damaged work, as identified by the Contract Administrator or Contractor.

.7 Cutting and Patching for Holes Required by Mechanical and Electrical work:

.1 Include under work of Divisions 20 and 26 cutting or provision of holes up to and including 50 square inches and related patching, except as otherwise indicated.

.2 Include under work of this Division holes and other openings larger than 50 square inches, and chases, bulkheads, furring and required patching. This Section shall be responsible for determination of work required for holes in excess of 50 square inches.

.8 This Section shall be responsible for all cutting and patching in addition to that specified for mechanical and electrical work, and shall directly supervise performance of cutting and patching by other Sections.

.9 Patching or replacement of damaged work shall be done by the Subcontractor under whose work it was originally executed, and at the expense of the Subcontractor who caused the damage.

.10 Make patches as invisible as possible in final assembly to the approval of the Contract Administrator/ the City. Unacceptable work will be replaced at no charge to the City.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

1 General

1.1 ADMINISTRATIVE

.1 Schedule and administer meetings every 2 weeks (or more frequently as required) with the Contract Administrator throughout the progress of the Work. Schedules to be updated with the Contract Administrator every 2 weeks for distribution at each meeting.

.2 Prepare agenda for such meetings.

.3 The Contractor shall chair such meetings. The Contractor shall administer such meetings and prepare minutes within three (3) days after the meeting date for distribution to the City and the Contract Administrator.

.4 Distribute written notice of each meeting four (4) days in advance of meeting date to the Contract Administrator and the City and other affected parties.

.5 Representatives of parties attending meetings shall be authorized to act on behalf of the parties they represent. Subcontractors and Suppliers do not attend meetings unless authorized by the Contract Administrator and the City.

.6 Prepare and distribute monthly progress reports in accordance with Section 01 32 16 – Construction Progress Schedule, and containing updated schedules, construction photos in accordance with Section 01 33 00 – Submittal Procedures, shop drawing logs, requests for interpretation logs, submittals and budget.

1.2 CONTRACT START-UP MEETING

.1 Participate in the Contract Administrator project start-up meeting. Contractor attendees shall be the Contractor's Project Manager, Contractor's Procurement Lead, Contractor's Site Superintendent, Contractor's Quality Manager, Contractor's Environmental Lead, and the Contractor's Discipline Coordinator(s).

.2 Contract Administrator will distribute project start-up meeting agenda and minutes.

1.3 PRE-INSTALLATION MEETINGS

.1 During the course of the Work prior to Substantial Performance of the Work, schedule pre-installation meetings as required by the Contract Documents and coordinated with the Contract Administrator.

.2 As far as possible, pre-installation meetings shall be scheduled to take place on the same day as regularly scheduled progress meetings.

.3 Agenda to include the following:

.1 Appointment of official representatives of participants in the Project.

.2 Review of existing conditions and affected work, and testing thereof as required.

.3 Review of installation procedures and requirements.

.4 Review of environmental and site condition requirements.

.5 Review of schedules and scheduling procedures and requirements of the applicable portions of the Work in accordance with Section 01 32 16 – Construction Progress Schedule, in particular:

.1 Schedule of submission of samples, mock-ups, and items for Contract Administrator's consideration.

.2 Delivery schedule of specified equipment.

.3 Requirements for notification for reviews. Allow a minimum of two (2) Working Days notice to Contract Administrator for review of the Work.

.6 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences, Section 01 50 00 – Temporary Facilities and Controls.

.7 Requirements for inspections and tests, as applicable.

.1 Schedule and undertake inspections and tests in accordance with Section 01 32 16 – Construction Progress Schedule and Section 01 40 00 – Quality Requirements.

.8 Special safety requirements and procedures.

.4 The following shall be in attendance:

.1 Contractor.

.2 Subcontractors affected by the work for which the pre-installation meeting is being conducted.

.3 Contract Administrator.

.4 Manufacturer's representatives, as applicable.

.5 Inspection and testing company, as applicable.

1.4 PROGRESS MEETINGS

.1 During the course of the Work prior to Substantial Performance of the Work, schedule progress meetings every two (2) weeks.

.2 In advance of progress meetings, Contractor shall submit to the Contract Administrator a two week look ahead schedule of items of work to be undertaken in the two weeks subsequent to the progress meeting. Two week look ahead schedule will be reviewed at the meeting and recorded in the minutes of the meeting. Refer to Section 01 32 16 – Construction Progress Schedule for requirements for look ahead schedule.

.3 Attendees at progress meetings shall include the following:

.1 Contractor.

.2 Contractor's site superintendent(s).

.3 Contract Administrator.

.4 City's Representative.

.4 Agenda to include the following:

.1 Review, approval of proceedings of previous meeting.

.2 Review of items arising from proceedings.

.3 Review of progress of the Work since previous meetings.

.4 Review of schedules in accordance with Section 01 32 16 – Construction Progress Schedule, including:

.1 Revisions to construction schedule.

.2 Progress and schedule for subsequent period of the Work: Two (2) week look-ahead.

.3 Problems that impede compliance with construction schedule.

.4 Review of off-site fabrication delivery schedules.

.5 Review of material delivery dates/schedule.

.6 Corrective measures and procedures to regain construction schedule.

.7 Review of submittal schedules: expedite as required.

.5 Field observations, problems, conflicts.

.6 Review status of submittals.

.7 Maintenance of quality standards.

.8 Pending changes and substitutions.

.9 Review of Contract modifications and interpretations including but not limited to: requests for interpretation and log, proposed contract change, Change Orders, Change Directives, Supplemental Instructions, for effect on construction schedule and on Contract Time.

.10 Review of status of as-built documents.

.11 Other business.

1.5 PRE-TAKEOVER MEETING

.1 Prior to application for Substantial Performance of the Work, schedule a pre-takeover meeting.

.2 Agenda to include the following:

.1 Review, approval of proceedings of previous meeting.

.2 Review of items arising from proceedings.

.3 Review of procedures for Substantial Performance of the Work, completion of the Contract, and handover of the Work.

.4 Field observations, problems, conflicts.

.5 Review of outstanding Contract modifications and interpretations including but not limited to: requests for interpretation and log, proposed contract change, Change Orders, Change Directives, Supplemental Instructions, for effect on construction schedule and on Contract Time.

.6 Problems which impede Substantial Performance of the Work.

.7 Review of procedures for deficiency review. Corrective measures required.

.8 Progress, schedule, during succeeding period of the Work.

.9 Review submittal requirements for warranties, manuals, and all demonstrations and documentation required for Substantial Performance of the Work.

.10 Review of status of as-built documents and record drawings.

.11 Other business.

1.6 POST-CONSTRUCTION MEETING

.1 Prior to application for completion of Contract, schedule a post-construction meeting. Four days prior to date for meeting, Contract Administrator shall confirm a date for meeting based on evaluation of completion requirements.

.2 Agenda to include the following:

.1 Review, approval of proceedings of previous meeting.

.2 Confirmation that no business is arising from proceedings.

.3 Confirmation of completion of the Contract, and handover of reviewed documentation from the Contract Administrator to the City.

.4 Confirmation of completion of proposed Change Orders, Change Orders, Change Directives, and Supplemental Instructions.

.5 Problems that impede Contract completion.

.6 Identify unresolved issues or potential warranty problems.

.7 Confirmation of completion of deficiencies.

.8 Corrective measures required.

.9 Confirm submittal requirements for warranties, manuals, and demonstrations and documentation for Contract completion are in order.

.10 Review of procedures for communication during post-construction period.

.11 Handover of reviewed record documents by the Contract Administrator to the City.

.12 Handover of Contract completion insurance policy transcripts by Contractor.

.13 Submission of final application for payment.

.14 Review and finalize outstanding claims, pricing, and allowance amounts.

.15 Status of commissioning and training.

.16 Demobilization and the Place of the Work restoration.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

1 General

1.1 PLANNING, SCHEDULING AND MONITORING - GENERAL

.1 This section includes requirements for the preparation, monitoring and revision of construction schedules.

.2 The Contractor shall develop the Project Schedules in compliance with all requirements of the Contract. The schedules shall include a level of detail sufficient to meet the satisfaction of the Contract Administrator.

.3 The Contractor shall develop the Project Schedules in accordance with Good Industry Practice in Scheduling and in compliance with the requirements of the Contract.

.4 The Contractor shall break down the scope of works into Work Breakdown Structure (WBS) levels, activities, and milestones, incorporating appropriate phases, work locations, sequencing, interdependencies, and logic to reflect its overall approach to planning and executing the works.

.5 The purpose of the schedules and reports mandated in this section is to:

.1 Ensure adequate planning and execution of the Work by the Contractor;

.2 Establish the standard against which satisfactory completion of the project will be judged;

.3 Assist the City and the Contract Administrator in monitoring progress;

.4 Assess the impact of changes to the Work.

.6 The Contractor has the obligation and responsibility at all times to plan and monitor all of its activities, anticipating and scheduling its staff, materials, plant and work methods in a manner that is likely to ensure completion of the Work in accordance with the terms and conditions of the Contract and at a rate that will allow the Work to be completed on time.

1.2 CPM SCHEDULING GENERAL REQUIREMENTS

.1 The schedules required by this section shall take the form of time-scaled diagrams prepared using a computerized scheduling system, capable of producing resource-and/or cost-loaded Critical Path Method (CPM) schedules.

.2 General requirements applicable to all schedules include the ability to:

.1 Easily summarize, group, sort and filter activities by area, phase or other categorization as applicable, or any combination thereof;

.2 Electronically compare any given schedule with any previous or subsequent update;

.3 Generate monthly progress claims and cash flow projections through resource and cost loading activities;

.4 Show schedules in bar chart, network diagram and time scaled logic diagram formats;

.5 Apply different calendars to applicable activities; and

.6 Transmit schedules electronically via e-mail attachments.

.3 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated and allow coordination and control of project activities. Show continuous flow from left to right.

.4 Float is defined as the amount of time between the earliest start date and the latest start date of an activity or chain of activities on the CPM schedule. Ensure activities with no float are calculated and clearly indicated on logical CPM construction network system as being, whenever possible, continuous series of activities throughout Contract Time to form "Critical Path".

.5 Use of float suppression techniques such as software constraints, preferential sequencing, special lead/lag logic restraints, extended activity times, or imposed dates, other than as required by the Contract, shall be cause for the rejection of any schedule submitted by the Contractor.

1.3 CPM SCHEDULING TECHNICAL REQUIREMENTS

.1 The Contractor shall provide all Project Schedules to be aligned with the AACE International Recommended Practices and PMI's "A Guide to the Project Management Body of Knowledge (PMBOK® Guide, edition 7th).

.2 The Contractor shall develop the Project Schedules using Primavera P6 Professional software, in the native file format which shall be exported to .XER file.

.3 The Contractor shall include project name, schedule version and number, and data date in the submitted files name. For example, ABCD-R01-20250731

.4 Project schedule should demonstrate, in a clear and detailed way, the Contractor's construction sequencing and planned execution of the works and it should be logic driven.

.5 Each activity or milestone should have a unique activity identification number (activity ID) and name.

.6 Activity ID should include letter and number which specifies activity for locations, phases, and type of works.

.7 Activity name should include descriptions that begin with a verb or work function followed by an object, and contain a location, phase, and type of work

.8 Original durations as defined in the project schedule should be based on working days and not calendar days

.9 Zero duration activities shall be coded as milestones and not activities

.10 Original duration in all Task Dependant activities should be estimated based on normal manpower and equipment utilization and should be less than 15 working days unless otherwise approved by the City and Contract Administrator's Advisor.

.11 For the schedule update, the remaining durations shall be manually entered into the software

.12 The actual duration shall be recorded for all completed activities

.13 Each activity shall have an assigned calendar

.14 The project schedule shall not have any open-ended activities. Each activity shall have, at a minimum, one predecessor and one successor, and each activity shall have a start and a finish relationship. Project start and completion milestones are exceptions

.15 The project schedule shall not use the start-to-finish (SF) activity relationship type between activities unless otherwise agreed to by the City and Contract Administrator's Advisor

.16 For each start milestone, the project schedule shall not only define a finish-to-start (FS) or start-to-start (SS) relationship with its predecessor, a start-to-start (SS) or start-to-finish (SF) relationship with its successor, a start-to-start (SS) relationship with any other start milestone, or a start-to-finish (SF) relationship to a finish milestone;

.17 For each finish milestone only define a finish-to-finish (FF) or start-to-finish (SF) relationship with its predecessor, a finish-to-start (FS) or finish-to-finish (FF) relationship with its successor, a finish-to-start (FS) relationship to any other start milestone, or a finish-to-finish (FF) with any other finish milestone;

.18 The Project Schedule shall not contain any open start or open finish activities, for clarity, all activities shall have a relationship that defines the requirements for the finishing of that activity; each Activity shall have a finish-to-start (FS) or finish-to-finish (FF) relationship with another successor activity;

.19 The Project Schedule shall not contain a negative lag between any activities and/or milestones unless substantiated by the Contractor and accepted by the City and Contract Administrator's Advisor.

.20 The Project Schedule shall contain only positive lag between activities and/or Milestones, to model a specific waiting duration for a process directly related to the predecessor Activity in the narrative reports.

.21 The monthly progress schedules shall not have any out-of-sequence relationships, where the schedule does not respect the activities relationship. For example, when an activity has started and the (FS) predecessor activity has not finished yet.

.22 The Contractor shall not enter or assign any progress data for any activity after the Data Date

.23 The Contractor shall not make any changes to the WBS in any Progress Schedule without obtaining prior written consent from the Contractor Administrator.

.24 The Contractor shall assign cost values, labor resources, and quantities only to task-dependent activity types in any Project Schedule. No cost values, labor resources, or quantities shall be assigned to level-of-effort activities.

.25 The Contractor shall not adjust the reported physical progress percentage for any schedule activities without obtaining prior written consent from the Contractor Administrator.

.26 The Contractor shall not modify any actual data reported in a Progress Schedule without prior written consent from the Contractor Administrator.

.27 The Contractor shall not change the activity ID in any Project Schedule without obtaining prior written consent from the Contractor Administrator.

.28 The Contractor shall not change the activity name for any activity in the Project Schedule unless approved by the Contractor Administrator.

.29 The Contractor shall not amend or modify the original duration for any activity in a Progress Schedule without prior written consent from the Contractor Administrator.

.30 Retired Works Activities:

.1 A "Retired Works Activity" refers to an activity or group of activities that are no longer needed and have been removed from the Agreement.

.2 If Contractor wishes to delete an activity or milestone in any Progress Schedule, a "Retired Activities" node must be created at WBS level 2, and the retired activity will be moved to this WBS band.

.3 All logic dependencies for retired activities must be removed.

.4 The Progress Schedule logic must be adjusted to prevent open ends, ensuring schedule integrity. Any changes must be documented in the Change Log.

.5 Retired activities and milestones must have an actual start and finish date reflecting the month and year of deletion. The activity description should be updated to include "Retired" as a prefix.

.6 All codes, cost, quantity, and labor resource values for retired activities must be removed. Any associated values should be reassigned to a "not-completed" activity, and the explanation for the reassignment must be recorded in the Change Log.

.31 The Contractor shall use unconstrained sequencing logic and avoid using imposed date constraints to replace or limit sequencing logic for any activity or milestone,

.32 Constraints, if used, must only be of the "start on or after" or "finish on or before"

.33 The total number of constrained activities must be less than 5% of all activities and must be approved by the Contractor Administrator.

.34 Any Works Activity shall not be less than one working day and no more than 15 Working days

.35 Calendars

.1 The Contractor shall define and use non-global, project-specific calendars for activities, with each calendar having:

.1 A clear, descriptive name understandable to the Contractor Administrator, starting with "Project name" (e.g., "WINNIPEG – ABCD – Winter Calendar").

.2 Working days and Hours based on this Contract and relevant approvals, along with non-working days.

.3 All non-working days, including statutory holidays, winter shutdowns, and any restricted periods throughout the project.

.4 The first day of each workweek set as Monday.

.2 The Contractor shall not use global calendars.

.3 Activity durations must be in full working days, without fractional durations (e.g., no 5.5 days).

.36 Critical Path:

.1 The Contractor shall identify and show the Critical Path to achieve Project Substantial completion. The Critical Path must be calculated using the "retained-logic" scheduling method without using a progress override option.

.2 The total number of Critical Path activities should be between 10-15% of all activities. If it exceeds 15%, justification is required.

.3 Near-Critical Activities: If requested by the Contractor Administrator, the Contractor must identify all activities with total float up to 10 working days.

.37 The Contractor shall use Physical Percent complete type for all Task Dependant Activities which is representing the physical completion of the activity (activities shall not use any other completion type such as Duration Percent complete or Unit Precent complete type);

.38 For the Level of Effort Activities, Contractor could use Duration Percent complete as an exception.

.39 The Contractor shall submit all progress measurements, earned value management, schedule analysis graphs and curves in Microsoft excel and pdf format.

.40 The Contractor shall define and assign some Activity Codes for Phasing, Type of works for each geographical location, Design and Construction works responsibilities in order to have proper grouping ad sorting activities to meet monitoring and reporting requirements

.41 The Contractor shall develop a fully Cost-loaded Schedules which means all activities should be associated with the cost values greater than zero representing the actual prorated the Contractor cost to perform each activity, and the sum of all the activity cost allocations shall be compliant with Contract schedule values and equal to the total Contract Price.

.42 The Contractor shall develop a fully Resource-loaded Schedules which means each activity with a cost value should be associated with the quantity representing the primary physical dimension of the Works element. The quantity shall be purely used as an indicator of level of efforts and production rate estimated and the unit of measure could be “units”, “m”, “m2”, “m3”, “tons” or “sum” according to the Activities type of works (where no definable dimension exists, the unit type shall be “sum” and the quantity shall be set to “100”)

.43 The Contractor shall develop a fully Resource-loaded Schedules which means each activity with a cost value should be associated with the labour hours representing all planned person-hours employed, to achieve each of the Activities. The labour hours should be calculated based on the different crew hours which are assigned to the different type of works.

.44 Additionally, the Contractor shall use this data to calculate and include the following performance indicators in the monthly Works Schedule Progress Report:

.1 Planned Value (PV), calculated up to the Schedule Status Date;

.2 Earned Value (EV), calculated up to the Schedule Status Date;

.3 Schedule Performance Index (SPI), calculated as SPI = Earned Value (EV) / Planned Value (PV)

.45 Each activity associated with a Variation Confirmation shall be cost-loaded with the agreed value. However, the value of these Variation Confirmations shall not be included in calculations of Planned Value and Earned Value, unless the Variation Confirmation results in an adjustment to the As Planned (Baseline Schedule)

1.4 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Schedules shall be submitted to the Contract Administrator in both PDF format and original software data file format within ten (10) days of Contract Award for the City/Contract Administrator review.

.3 City and Contract Administrator will review schedule and return review copy within ten (10) days after receipt.

.4 Resubmit finalized schedule within five (5) days after return of review copy.

.5 Electronic schedule submissions shall be in an original scheduling software data file type that permits modification of the layouts and data.

.6 Include costs for execution, preparation and reproduction of schedule submittals in tendered price.

.7 Submission of the schedules referred to in this Section shall constitute the Contractor's representation that:

.1 Contractor and its Sub-Contractors intend to execute the Work in the sequence indicated on such schedule;

.2 Contractor has distributed the proposed schedule to its Sub-Contractors for their review and comment, and has obtained their concurrence;

.3 All elements of the Work required for the performance of the Contract are included. Failure to include any such element shall not excuse the Contractor from completing the Work within the Contract Time and within any other constraints specified in the Contract;

.4 Seasonal weather conditions have been considered and included in the planning and scheduling of the Work influenced by high and low ambient temperatures and/or precipitation;

.5 Contractor has thoroughly inspected the Site and has incorporated any other special conditions in planning the Work such as specified or required non-work periods, etc.

.6 Contract Administrator review time of submittals and shop drawings as specified has been accounted for in project schedule.

.8 Cash flow diagram:

.1 Contractor shall submit an updated cash flow diagram quarterly.

.2 Cash flow diagram shall be in format acceptable to the City.

.3 Cash flow diagram shall represent Contractor's anticipated invoicing.

1.5 QUALITY ASSURANCE

.1 Use experienced personnel, fully qualified in planning and scheduling to provide services from the commencement of the Work through to the issuance of the Completion Payment Certificate.

.2 Contractor to employ a Project Scheduler with a minimum of 5 years' experience working with Primavera P6. Contractor to submit proposed Scheduler's resume to the City and Contractor Administrator's Advisors approval. Once approved Contractor shall not replace approved scheduler without approval of the City or Contractor Administrator's Advisors.

1.6 PRELIMINARY BASELINE SCHEDULE

.1 Meet with City and Contract Administrator within five (5) working days of Contract award, to discuss proposed approach for undertaking the Work, inclusive of methodology, sequencing, construction equipment, and labour resources to be utilized.

.2 Prepare a detailed CPM schedule (the preliminary Baseline Schedule), illustrating the Contractor's plan for executing the Work, indicating the times for starting and completing the various stages of the Work and any applicable constraints. The preliminary as planned schedule should refine and amplify the Contractor's tender schedule and must provide sufficient detail of the critical events and their interrelationship to demonstrate that the Work will be performed within the Contract Time.

.3 The preliminary Baseline Schedule shall cover all phases of the Work, and shall represent a practical plan to complete the Work, considering restrictions of access and availability of Work areas, and availability and use of manpower, materials and equipment. The preliminary Baseline Schedule shall show the activity duration, sequencing and interdependencies for the following:

.1 Preparation of Shop Drawings and material samples;

.2 Review and approval of Shop Drawings and material samples;

.3 Permitting;

.4 Material procurement;

.5 Fabrication;

.6 Temporary works;

.7 Installation;

.8 Inspection/testing; and

.9 Handover.

.4 Each activity shall be coded by the performing entity such as a particular Sub-Contractor, supplier, the Contract Administrator, etc.

.5 The activities defined in the preliminary Baseline Schedule shall represent the planned durations in anticipation of normal manpower and equipment utilization in durations of whole working days. Except for non-construction activities, such as procurement, delivery or submittals, no activity durations shall exceed fifteen (15) working days unless approved by the Contract Administrator. The durations shall be determined based upon resource planning under contractually-defined on-site work conditions. In calculating activity durations, normal inclement weather shall be considered. The Contractor shall schedule the Work to minimize the effect of adverse weather, and to allow for protection of the Site from such effects.

.6 The total number of activities and the distribution of activities shall reflect the complexity of the Work and shall be finite, measurable, identify a specific function and identify a trade responsible for its completion.

.7 Prepare a narrative (named Baseline Schedule Assumption Report) to accompany the preliminary Baseline Schedule that provides a detailed description of the labour, materials, plant, means and methods that the Contractor intends to utilize in carrying out the Work to achieve the planned rates of production required to support the activity durations shown in the schedule. The narrative shall also provide explanations supporting the use of lead-lag relationships and, where permitted, constrained dates. The Baseline Schedule Assumption Report shall include the following sections and related content:

.1 An Implementation Strategy – A written narrative describing the overall approach, proposed sequencing, and work plan to achieve Substantial Completion of the Works.

.2 Critical Path Risk – A tabular narrative identifying risks associated with completing critical path activities for Substantial Completion and outlining The Contractor's mitigation or avoidance strategies.

.3 Planned Working Calendar – A table defining all schedule calendars, including:

.1 Workdays (days of the week)

.2 Normal working hours

.3 Number and hours of shifts

.4 List of assumed non-working days (e.g., holidays, environmental restrictions).

.4 Means and Methods – An executive summary detailing the intended means and methods for major elements including:

.1 A brief narrative on the type of work

.2 Any constructability challenges

.3 Whether the work will be self-performed by the Construction Contractor or subcontracted.

.5 Resource Plan – Including:

.1 Number of teams and their composition (manpower requirements), including subcontracted work.

.2 Number and type of heavy machinery or equipment.

.3 Anticipated resource constraints (e.g., union-related limitations, availability of specific heavy machinery in the region).

.4 A brief narrative describing how the Contractor intends to meet resource requirements.

.6 Planned Production Rates – A table listing all key Works Activities with the assumed production rate for each activity (expressed as quantity per working day, e.g., m/day, m^2/day, or m^3/day).

.7 General Assumptions – Any other scheduling assumptions, including known or foreseeable constraints and restrictions such as weather conditions, traffic impacts, environmental limitations, or utility-related constraints.

.8 The Baseline Schedule shall have the status date matches the "Financial Close" or "Effective Date".

.9 The Baseline Schedule shall not have any progress data for any activity or Milestone.

1.7 PRELIMINARY BASELINE SCHEDULE SUBMISSION AND REVIEW

.1 Within ten (10) days after Contract award, submit to the City and Contract Administrator to review:

.1 One (1) electronic copy of the preliminary Baseline Schedule, clearly labelled with data date, specific update, and person responsible for update.

.2 One (1) electronic copy of bar chart identifying coding, activity durations, early/late and start/finish dates, total float, completion as percentile, current status and budget amounts.

.3 One (1) electronic copy of network diagram showing coding, activity sequencing (logic), total float, early/late dates, current status and durations.

.4 One (1) electronic copy of written narrative as described in paragraph 1.5.7 above.

.2 The City and the Contract Administrator will review and return the preliminary Baseline Schedule within ten (10) days after receipt.

.3 The preliminary Baseline Schedule must be acceptable in principle to the City and the Contract Administrator, prior to the release of the first progress payment.

1.8 FINAL BASELINE SCHEDULE AND CASH FLOW

.1 The Contractor shall submit all revisions and/or additional information requested by the City or the Contract Administrator pursuant to their review of the preliminary Baseline Schedule if the Contract Administrator considers that these additions are necessary for the preliminary Baseline Schedule to comply with the requirements of this section. The required revisions must be made and the Baseline Schedule finalized to the satisfaction of the City and the Contract Administrator (whereupon it will become the final Baseline Schedule, against which progress will be measured) within thirty (30) working days after Contract Award.

1.9 FINAL BASELINE SCHEDULE SUBMISSION, REVIEW AND APPROVAL

.1 The Contract Administrator will accept the final Baseline Schedule if it demonstrates that the Work will be performed in an orderly manner and in conformity with the Contract Time, subject to the constraints set out in the Contract, but such acceptance will neither impose on the City or the Contract Administrator responsibility for the sequencing, scheduling or progress of the Work nor interfere with or relieve the Contractor from the Contractor's full responsibility therefore. Acceptance of the final Baseline Schedule or any subsequent update by the City shall not be construed as a confirmation that the schedule is a reasonable plan for performing the Work.

.2 Acceptance of final Baseline Schedule showing scheduled Contract duration shorter than specified Contract duration does not constitute change to Contract Time.

.3 Consider final Baseline Schedule showing Work completed in less than specified Contract duration, to have float.

1.10 COMPLIANCE WITH CONTRACT SCHEDULE

.1 The Contractor shall adhere to latest schedule approved by the Contract Administrator.

.2 The express or implied acceptance by the City or the Contract Administrator of the final Baseline Schedule and any progress schedules shall not constitute an approval or acceptance of the Contractor's construction means, methods, or sequencing or its ability to complete the work in a timely manner, and shall not place any obligation or responsibility on the City towards the Contractor nor in any way limit the Contractor's obligations and responsibilities.

1.11 PROGRESS MONITORING

.1 The Contractor shall monitor progress of the Work in detail to ensure integrity of critical path, by comparing actual completions of individual activities with their scheduled completions, and reviewing progress of activities that have started but are not yet completed. Monitoring should be undertaken sufficiently often so that causes of delays are immediately identified and removed if (or a remedial action taken) possible.

.2 On an ongoing basis, record "progress to date" on copy of schedule to be available at the Site. Inspect Work with the City and the Contract Administrator at least bi-weekly to establish progress on each current activity.

1.12 UPDATES AND REVISIONS TO SCHEDULE – SUBMITTING MONTHYLY PROGRESS SCHEDULES

.1 After Baseline Schedule Approval by the City, the Contractor's Baseline Schedule is to be updated and resubmitted to the Contract Administrator as a progress schedule at least once per month, on a date to be mutually agreed by the Contractor and the Contract Administrator, together with the related data and reports required by this Section. Updated schedule is to include a 2 week look-ahead schedule in the form of a bar chart. The below listed items apply to Progress Schedule:

.1 Submission Deadline: No later than three (5) business days after the last day of each month.

.2 Review Process: The Contract Administrator shall review the submission in accordance with the Contract.

.3 Compliance: All Progress Works Schedules submitted by the Contractor shall adhere to the contractual and procedural requirements set in the Contract.

.4 Shall have the Data Date as the first calendar day of the next month at 00:00 AM unless otherwise agreed between the Contractor and the Contract Administrator.

.5 Include Key Project Data including cost values, quantities, labor resources, machinery, and equipment for key resourced activities, in accordance with the Contract.

.6 Shall document Construction Progress with three Activity bars:

.1 Current Bar (updated to month-end)

.2 Previous Month's Progress Works Schedule

.3 Baseline Works Schedule

.7 The schedule must show all Key Milestones, clearly indicating the variance between each baseline date and the current date of the corresponding milestone.

.8 Any additional milestones or activities reasonably requested by the Contract Administrator must be included in the Progress Schedule.

.2 Each progress schedule shall record and report actual completion and/or start dates for each completed or in-progress activity, activity percent complete for in-progress activities and forecast completion dates for all activities that are not yet complete. Do not automatically update actual start and finish dates by using default mechanisms found in scheduling software. The progress schedule will show the projected completion date of the Work based on the progress information inserted into it, without changes to the schedule logic or the original duration of any activity. The Contractor shall use the retained logic option when executing schedule calculations. The final Baseline Schedule (or an approved revision thereto) will be shown as a target schedule to indicate whether the current progress schedule remains on target, has slipped or is ahead of schedule.

.3 The Contractor may then, in a second and subsequent update to the progress schedule, incorporate any logic and duration changes that represent its revised planning, provided all such changes are identified and documented in the schedule narrative required to accompany the progress schedule, and are agreed to by the Contract Administrator.

.4 If it appears that the progress schedule submitted by the Contractor no longer represents the actual sequencing and progress of the Work, the Contract Administrator may instruct the Contractor to revise the progress schedule.

.5 In order to improve the schedule, eliminate unforeseen problems or reduce the time required for an activity, modifications to the schedule may be suggested by the Contractor, Sub-Contractors, City or Contract Administrator during the execution of the Contract, and such modifications may be implemented by mutual agreement. The Contractor shall submit to the Contract Administrator for acceptance proposed adjustments to the final Baseline Schedule or any subsequent updates that will not change the Contract Time.

.6 If, at any time, the work is behind schedule with respect to the progress schedule currently in force, and if the Contract Administrator believes there is a risk of the Work not being completed within the Contract Time as a result of such delay, the Contractor shall take all necessary measures to make up for such delay either by increasing staff, plant or facilities, or by amending its work methods, whichever is applicable.

.7 In all cases of delay or potential delay, the Contractor shall keep the City and the Contract Administrator informed of its intentions with regard to mitigation of such delay and the City's Contract Administrator may, if it is deemed necessary, require the Contractor to revise all or part of its current progress schedule.

.8 The current Contract Schedule can only be revised as agreed with the City and the Contract Administrator by Change Order or an accepted revision to the logical sequence of described construction operations.

.9 Once accepted, the revised schedule will become the current Contract Schedule against which progress is reported and to which subsequent updates will be compared. The new Contract Schedule will be clearly identified to show it as the current Contract Schedule.

.10 Where the progress schedule shows completion of the Contract, or of any interim milestone, later than the Contract or milestone completion dates, acceptance of such progress schedules and of the monthly progress report will not constitute acceptance of the delay by the Contract Administrator or the City.

1.13 EXTENSIONS OF TIME

.1 Float shall not be for the exclusive use of either the Contractor or the City. Extensions to the Contract Time will be granted only to the extent that appropriate adjustments to the duration of the affected activity exceed the total float time along the affected paths of the progress schedule in force at the time a Change Order or Change Directive is issued.

.2 Submit to the Contract Administrator, justification, project schedule data and supporting evidence for approval of extension to the Contract Time or interim milestone date when required. Include as part of supporting evidence:

.1 Written submission of proof of delay based on revised activity logic, duration and costs, showing time impact analysis illustrating influence of each change or delay relative to approved Contract Schedule.

.2 Prepared schedule indicating how change will be incorporated into the overall logic diagram. Demonstrate perceived impact based on date of occurrence of change and include status of construction at that time.

.3 Other supporting evidence requested by the Contract Administrator.

1.14 MONTHLY SCHEDULE PROGRESS REPORTS

.1 The Contractor shall submit a Monthly Schedule Progress Report in a monthly basis in which:

.2 Shall be prepared by the Contractor and submitted to the Contract Administrator in the form of one (1) electronic copy of the relevant schedule files, to demonstrate how the Work is actually progressing and the planned and detailed sequencing of the Work at the time of the report. The cut-off date for the monthly progress report shall be as instructed by the Contract Administrator and the report shall be submitted no later than ten (10) Working Days after the cut-off date and accompanying the monthly progress draw.

.3 Each monthly progress report shall be in a format acceptable to the City, and shall be arranged according to the following headings and sub-headings:

- .1 Executive Summary.
  - .1 Activity to (date).
  - .2 Forecast activity to (date).
- .2 Project Cost Information:
  - .1 Budget Summary.
  - .2 Cash Allowance Log.
  - .3 Change Order Log.
- .3 Project Data:
  - .1 Project Schedule.
  - .2 Shop Drawing Log.
  - .3 Site Inspection Log.
  - .4 Site Testing Log.
- .4 Critical Issues Log.
- .5 Site Photos.

.4 The Contractor shall submit a report with each monthly progress schedule including following content and sections:

- .1 A cover page including the title “Schedule Progress Report”, the Project title, date of the report, issuance date, version date, and the version number
- .2 “Section 1 – Executive Summary”, including an executive summary of progress of the Works, key milestones achieved, schedule variances, critical path, and issues and delays that have or that may impact the schedule
- .3 “Section 2 – Schedule Analysis” including:
  - .1 Key Milestone table showing variances between current monthly schedule and previous monthly schedule and Baseline schedule.
  - .2 List of delayed activities compared to the Baseline schedule
  - .3 List of started and/or completed activities during the reporting period
  - .4 Description of Project status in different phases and geographical locations
  - .5 Overall progress, expressed as the percentage of physical work completed.
  - .6 S-Curve, Earned Value, Planned Value, and Schedule Performance Index (SPI)
  - .7 To be reported in Project level and in WBS level 2

.4 "Section 3 – Critical Path Analysis" that includes the following information:

.1 Critical path description including the sequence of all critical activities starting from data date till Project completion. Explanation of any changes on the critical path compared to the previous monthly schedule.

.2 Near critical path description including a list of all activities that have become near critical path activities during this reporting period (Activities with total float les than 10 days)

.3 Detailed critical path and near critical path Gantt Chart

.5 "Section 4 – Schedule Change Log" that includes the list of below changes and the reason of them which made compared to the previous monthly schedule. In case of developing a revised baseline schedule, these changes should be logged comparing to the baseline schedule:

.1 Changes in WBS

.2 Addition and deletion activities

.3 Changes to activity relationships

.4 Changes to activity durations;

.5 Changes to the activity calendar;

.6 Changes to activity assigned cost value

.7 Changes to activity assigned labour resources (person-hour);

.8 Changes to activity assigned quantity

.9 Addition and deletion of calendars

.10 Addition and deletion of constraints

.11 Changes in activity ID and activity name

.12 Changes in actual start and finish date

.6 "Section 5 – Labour Resources", including,

.1 A graphical and tabular presentation by labour resource (crews) utilization showing baseline planned resource hours, actual resource hours, and estimate to complete hours per month and the cumulative curve

.7 "Section 6 – Actual Production Rates " including a table listing each type of works and indicating for each:

.1 actual Quantity and unit of measure;

.2 the actual production rate for each activity work type expressed as a Quantity per Working Hour (i.e. units/hr, ton/hr, m/hr, m2/hr, or m3/hr);

.3 a projection of the future work progress based on the actual production rates and required production rates to achieve the scheduled final completion date

.4 A graphical and tabular presentation by all Quantities showing baseline planned units, actual units, and estimate to complete unit per month and the cumulative curve

.8 "Section 7 – Earned Value Management and Progress Measurement", a data report presenting in the following tabular and graphical formats for each phase, location, and type of works detailing cumulative and monthly Earned Value metrics including:

.1 Schedule Variance: Comparison between planned value cost and earned value cost which is Schedule Performance Index (SPI)

.2 Progress Measurement: comparison between planned progress% and actual progress%

.3 Cash flow projection: Estimate to completion cost

.9 "Section 8 – Other" including any other information specifically requested by the City or Contract Administrator's Advisor

.5 Each monthly progress report shall include, but not limited to the following:

.1 An updated progress schedule, comparing actual and target progress for all milestones and activities. Sort activities by activity identification number and accompany with descriptions. List early and late start and finish dates together with durations, codes and float.

.2 Criticality report listing activities and milestones with up to five (5) days of total float used as first sort for ready identification of near critical paths through entire project. List early and late starts and finishes dates, together with durations, codes and float for critical activities.

.3 Progress report in early start sequence, listing for each trade, activities due to start, to be underway, or finished within two months from monthly update date. List activity identification number, description and duration. Provide columns for entry of actual start and finish dates, duration remaining and remarks concerning action required.

.4 A schedule narrative, including:

.1 Detailed descriptions of progress, including each stage of procurement, fabrication, delivery to site, construction, installation, and testing;

.2 Discussion of the basis for any work sequencing, logic, interdependencies or original activity duration revisions incorporated into an updated progress schedule; and

.3 Comparisons of actual and planned progress, with a brief commentary on any actual or forecast delays or problems that might have an impact on the completion. date of the Work, and a discussion of the measures being (or to be) adopted to overcome these.

.5 Charts showing the status of submittals, permits and approvals, utility relocations, purchase orders, manufacturing/fabrication and construction.

.6 For each fabricated item, the name and location of the fabricator, percentage progress, and the actual or expected dates of commencement of fabrication, Contractor's inspections, tests and delivery.

.7 Progress photographs taken, prepared, and submitted in formats specified, all in accordance with Section 01 33 00 – Submittal Procedures.

.8 RFI log.

.6 Timely submission of updates is of significant and crucial importance to the management of this project. Lack of or late receipt of updates diminishes their value to the City and the Contract Administrator. Therefore, if the Contractor fails to submit any progress schedule or required revision to a progress schedule within the prescribed time period, the City, in its sole discretion, may hold back subsequent progress payments until the updated schedule is submitted or the revision is accepted.

1.15 REVIEW OF MONTHLY PROGRESS REPORTS

.1 The monthly progress reports and progress schedules will be used by the City and the Contract Administrator to monitor the Contractor's performance against the current Contract Schedule.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

1 General

1.1 ADMINISTRATIVE

.1 Make submissions reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Work affected by submittal shall not proceed until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.

.6 Notify Contract Administrator, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are coordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator review.

.10 Keep one reviewed copy of each submission on site.

.11 Submit all submittals other than samples as one (1) single electronic PDF file.

.12 Name Submittal PDF files to include the following:

.1 Submittal Number.

.2 Spec Section Number.

.3 Revision Number: Reflect the number of submissions, zero is indicating the first submission.

.4 Description of Submission.

.13 Resubmit submittal shall maintain the original file name but revising the revision number.

1.2 SUBMISSIONS SCHEDULE

.1 Within four (4) weeks after award of Contract submit a submittal schedule itemizing submittal for review by Contract Administrator.

.2 Prepare a schedule of tentative dates for submittal submissions for Contract Administrator’s review.

.3 Allow fourteen (14) days for Contract Administrator's review of each submission.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 The term shop drawings means drawings, diagrams, illustrations, schedules, performance charts, product data, brochures and other data which are to be provided by the contractor to illustrate details of a portion of the work.

.2 Arrange for the preparation of clearly identified shop drawings as the Contract Administrator may reasonably request.

.3 Prior to submission to the Contract Administrator, review all shop drawings. By this review the contractor represents that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so and that he has

checked and coordinated each shop drawing with the requirements of the work and of the contract documents. Indicate the contractor's review of each shop drawing by stamp, date and signature of an authorized person.

.4 Submit shop drawings to the Contract Administrator for his review with reasonable promptness and in orderly sequence so as to cause no delay in the work or in the work of other contractors.

.5 Make changes in shop drawings which the Contract Administrator may require consistent with the contract documents and resubmit unless otherwise directed by the Contract Administrator. When resubmitting, notify the Contract Administrator in writing of any revision other than those requested by the Contract Administrator.

.6 Make shop drawings accurately to a scale sufficiently large to show pertinent features of the Work. Define the division of responsibility between different trades in the shop drawings.

.7 Show materials, methods of construction and attachment or anchorage, erection diagrams, connections and other details necessary to complete the work. Cross reference shop drawings to drawings and specifications.

.8 The review by the Contract Administrator is for the sole purpose of ascertaining conformance with the general design concept. The review shall not mean that the Contract Administrator approves the detail design inherent in the shop drawings, responsibility for which shall remain with the contractor, and such review shall not relieve the contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the contract documents. The contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of the work of all subtrades and work of other contractors.

.9 Any adjustments made on the shop drawings by the Contract Administrator are not intended to change the contract price. If the contractor deems that such adjustments effect the value of the work, he shall so state in writing before proceeding with the fabrication and installation of the work.

2 Products

2.1 TRANSMITTAL LETTER

.1 Accompany submissions with transmittal letter, in duplicate, containing:

.1 Date.

.2 Project title and number.

.3 Contractor's name and address.

.4 Identification and quantity of each shop drawing, product data and sample.

.5 Identification for initial submission or resubmission.

.6 Specification Section Number and Title.

.7 Other pertinent data.

2.2 SHOP DRAWINGS

.1 Submissions shall include:

.1 Date and revision dates.

.2 Project title and number.

.3 Name and address of:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

.4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.5 Details of appropriate portions of Work as applicable:

.1 Fabrication.

.2 Layout, showing dimensions, including identified field dimensions, and clearances.

.3 Setting or erection details.

.4 Capacities.

.5 Performance characteristics.

.6 Standards.

.7 Operating weight.

.8 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationship to adjacent work.

.2 Shop Drawings: Submit one (1) electronic copy of shop drawings for each requirement requested in specification Sections and as Contract Administrator may reasonably request.

.3 Product Data: Submit one (1) electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Contract Administrator where shop drawings will not be prepared due to standardized manufacture of product.

.4 Delete information not applicable to project.

.5 Supplement standard information to provide details applicable to project.

.6 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.7 Shop drawings will be returned to the Contractor with one of the following notations:

.1 When stamped "REVIEWED", distribute additional copies as required for execution of the Work.

.2 When stamped "REVIEWED AS NOTED", ensure that all copies for use are modified and distributed, same as specified for "REVIEWED".

.3 When stamped "REVISE AND RESUBMIT", make the necessary revisions, consistent with the Contract Documents and submit again for review.

.8 Only use shop drawings bearing "REVIEWED" or "REVIEWED AS NOTED" on the Work unless otherwise authorized by the Contract Administrator.

.9 Further revisions by Contractor on submittals bearing "REVIEWED" or "REVIEWED AS NOTED" are not permitted.

.10 Shop Drawings Indicating Engineering and Design to be Provided by the Contractor: Include seal and signature of a Professional Engineer registered in the Province of the Work.

2.3 SAMPLES

.1 At each major milestone stage, assemble and submit all relevant samples in context, at one time, in the following groups:

.1 Exterior Materials and Finishes

.2 Interior Materials and Finishes

.3 Ceiling Systems and Light Fixtures.

.4 Door Hardware

.5 Cover plates, grilles, etc., of Mechanical and Electrical Sections.

.2 Submit for review samples in triplicate as requested in respective specification Sections and as Contract Administrator may reasonably request. Label samples with origin and intended use.

.1 Technical specifications section.

.2 Product manufacturer's name and address.

.3 Product supplier's name and address.

.3 Deliver samples prepaid to Contract Administrator's business address.

.4 Notify Contract Administrator in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.5 Unless custom or precise colour and pattern is specifically described in the Contract Documents, whenever a choice of colour or pattern is available in a product, submit accurate colour charts from the manufacturer's standard range of colour and pattern charts to the Contract Administrator for selection.

.1 Unless all available colours and patterns have identical costs and identical wearing capabilities and are identically suited for the installation, completely describe the relative costs and capabilities of each.

.6 Adjustments made on samples by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.

.7 Make changes in samples which Contract Administrator may require, consistent with Contract Documents.

.8 Reviewed and accepted samples will become standard of quality of work and material against which installed Work will be verified.

2.4 PRE-CONSTRUCTION CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract and prior to commencing work, submit the following:

.1 Workplace Safety and Insurance Board status.

.2 Certified true copy of insurance.

2.5 TEST REPORTS

.1 Clearly show on each test reports or certification, the name and location of the Work, name and address of Contractor, quantity and date of shipment and delivery, and name of manufacturer or fabricating company. Ensure certificates are signed by an authorized representative of the manufacturing or fabricating company.

.2 Submit four (4) hard copies, or one (1) electronic copy of all test reports submitted with certificates of compliance showing date or dates of testing, the specified requirements for which the testing was performed and results of the test or tests.

2.6 CERTIFICATION OF PERSONNEL

.1 Provide certificates to establish qualifications of personnel employed on the Work where such certification is required by authorities having jurisdiction, by the Contract Administrator or by the Contract Documents.

3 Execution

3.1 SUBMISSION

.1 Make submittals well in advance of schedule dates for fabrication, manufacture, erection and installation to provide adequate time for reviews, securing necessary approvals, possible revisions and resubmittals, placing orders, securing delivery and to avoid construction delays.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Section includes, but is not limited to:

.1 General requirements, procedures, and controls for compliance to the Leadership in Energy and Environmental Design (LEED) Green Building Rating System for Building Design and Construction version 4 (LEED v4 BD+C) and version 4.1 (LEED v4.1 BD+C) including all Addenda, Clarifications, Credit Interpretation Rulings (CIR) and LEED Interpretations (LI).

1.2 RESPONSIBILITIES

.1 The extent of the Contractor's contribution to specific LEED Credits is outlined in the Specifications. It is the Contractor's responsibility to understand LEED Credit intents, responsibilities and requirements from sources including: LEEDv4 Reference Guide, CaGBC documents, reports and publications, CaGBC website: www.cagbc.org and USGBC website: www.usgbc.org

.2 The LEED Project Checklist (Scorecard) indicates 'Yes' and 'Possible ('?')' LEED Credits to which the Contractor is required to comply and contribute.

.3 The Contractor must submit documentation to support LEED Credits. The LEED Consultant will review submittals, request clarification, and submit the Project LEED Submission documents to LEED Online for LEED Certification.

.4 Prepare and submit all documentation at or before shop drawing stage, as required to support each LEED Credit as specified in this Section and all related Sections.

.5 Perform LEED activities, processes and procedures specified in this Section and all related Sections, referring to the Contract Documents and LEED documents.

.6 Prepare and submit all documentation at or before shop drawing stage, as required to support each LEED Credit as specified in this Section and all related Sections.

.7 Verify all products delivered to the Project site comply with the requirements specified in this Section and all related Sections prior to being incorporated in the building.

.8 Ensure attendance of all required Subcontractors and construction personnel at LEED construction meetings.

.9 LEED Credit requirements to obtain LEED Certification that are dependent on material selection may not be specifically identified as LEED requirements.

.10 LEED Credits required to obtain LEED Certification that are dependent on the Engineering design of the Project are not part of the scope of this Section.

.11 The scope of work as described in this Section includes but is not limited to work as described elsewhere in the Contract Documents.

1.3 RELATED REQUIREMENTS

.1 This Section provides an overview of the objectives and requirements relating to the work of the Contractor for the individual LEED credits identified in the LEED Project Checklist (LEED Scorecard). This Section includes but is not limited to:

.1 LEED Responsibilities and Procedures

.2 LEED Documentation and Submittals

1.4 RELATED SECTIONS

.1 Section 01 35 40.01 – LEED v4 Materials Form

.2 Section 01 57 13 – Erosion and Sedimentation Control

.3 Section 01 60 13 – LEED Product Requirements

.4 Section 01 74 19 – LEED Construction Waste Management

.5 Section 01 81 19 – LEED Indoor Air Quality Requirements

.6 Section 01 91 00 – General Commissioning Requirements

1.5 REFERENCES

.1 Canada Green Building Council (CaGBC) www.CaGBC.org

.2 US Green Building Council (USGBC) www.usgbc.org

.3 LEED Reference Guide for Building Design and Construction Version 4, 2013

.4 LEED Reference Guide for Building Design and Construction Version 4.1, 2019

.5 Minimum Program Requirements (MPRs) for LEED Canada Rating Systems

.6 LEED v4 Credit Form (English Version) on LEED Online

1.6 SUSTAINABLE DESIGN AND CONSTRUCTION REQUIREMENTS

.1 This project is registered to and will conform with the Leadership in Energy & Environmental Design (LEED®) Green Building Rating System, minimum Silver Certification level, as outlined in the LEEDv4 Reference Guide for Building Design and Construction (LEED BD+C v4) and all Addenda. Comply with all LEED® program requirements as noted throughout the Contract Documents.

.2 Where the term ‘LEED’ is used within these specifications it refers to the Leadership in Energy and Environmental Design Version 4 for Building Design and Construction (LEEDv4 BD+C) Rating System, with Version 4.1 compliance paths, and the requirements set forth in the LEEDv4 BD+C Reference Guide in effect at time of project Tender.

.3 Achieve a minimum of LEED Silver rating (50-59 LEED Credit points) for the Project and all LEED Prerequisites applicable to the Project Type.

.4 Provide all LEED-related data, information, drawings, and documentation relevant to specified products and systems as specified. Submit LEED data and information when requested in this Section.

.5 Provide all LEED-related information, documentation, corrective actions, and photographs relevant to specified plans and procedures as requested. Submit data, information and photographs when requested in this Section.

.6 Coordinate Subtrades to comply with all LEED requirements as noted in this Section.

.7 Comply with all related LEED Plans and processes as specified.

.8 Construct a sustainable building that is energy and resource efficient.

.9 Provide a safe, healthy and comfortable environment free of pollutants and toxins.

.10 Failure to provide products, conditions or methods of construction compliant with LEED Prerequisites and Credits will result in the City achieving a Certification level less than that specified, or no Certification at all; the City will reserve the right to seek compensation where failure to achieve Certification is a result of direct neglect or misrepresentation of any material, product, process, condition or construction method.

.11 LEED requirements apply to all Sections and Work of this Project, whether specifically indicated or not.

.12 Utilize the recommended and specified forms for tracking, documentation and complying with LEED requirements.

1.7 DEFINITIONS

.1 Definitions are supplementary to all laws, statues, and regulations effective in the Province of Alberta. Where definitions conflict, laws, statutes and regulations take precedent over the definitions below.

.2 LEED Product Documentation: submittal documentation required to verify any claim of product attributes including but not limited to: Environmental Product Declaration (EPD), Cradle-to-Cradle Certification, Health Product Declaration (HPD), recycled content, regional content, volatile organic compound (VOC) content, No Added Formaldehyde, Ultra Low Emitting Formaldehyde, California Department of Public Health General Emissions Testing certificate, Carpet and Rug Institute (CRI) Certification, FloorScore Compliance, GreenGuard Certification, No Lead, WaterSense eligible, Forestry Stewardship Council (FSC) compliance.

.3 Adhesives and Sealants: defined in the State of California South Coast Air Quality Management District Rule 1168 (http://www.aqmd.gov/rules/siprules/sr1168.pdf).

.4 Agrifiber: a composite product derived from agricultural waste fiber processed and mixed with resins to produce products similar to those derived from wood fibre.

.5 CARB: California Air Resources Board

.6 Carpet and Rug Institute (CRI) Green Label: a program established by the national trade association representing the Carpet & Rug Industry, to identify carpet products tested by an independent laboratory and meeting criteria for low VOC emissions.

.7 CDPH: California Department of Public Health. Of or relating to VOC general emissions evaluation Standard Method v1.2-2017.

.8 Chain of Custody Certification: Certificates signed by entities including forestry, sawmills, manufacturers and millworkers certifying wood used to make a product was obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2 Principles and Criteria.

.9 CFC: Chlorofluorocarbon; halogenated substances that have a significant impact on the Earth’s atmosphere through ozone depletion and contribution to global warming

.10 Composite Wood: Products manufactured using wood fibre, flake, chip, shaving, veneer, paper or agricultural material or byproducts, pressed with glue, resin, water repellant, and preservatives. Examples: particle board, MDF, OSB, plywood, and composite door cores

.11 Construction and Demolition Waste: Solid waste typically including building materials, off-cuts, packaging, trash, debris, and rubble resulting from construction and renovation.

.12 Enclosure: the exterior and semi-exterior portions of the building. Exterior consists of the elements of a building that separate conditioned spaces from the outside. Semi-exterior consists of the elements of a building that separate conditions space from unconditioned space or that encloses semi-heated space through which thermal energy may be transferred to or from the exterior or conditioned or unconditioned spaces.

.13 Environmental Product Declaration: a statement that the item meets the environmental requirements of ISO 14021-1999, ISO 14025-2006 and EN 15804, or ISO 21930-2007

.14 FloorScore: certification program established by the Resilient Floor Covering Institute (RFCI) with SCS Global Services to identify hard surface flooring and hard surface flooring adhesives that meet strict IAQ requirements

.15 Forestry Stewardship Council (FSC): an international certification and labelling system dedicated to promoting responsible forest management of the world's forests.

.16 Formaldehyde: a compound that readily decomposes at room temperature. Prohibited from use in the building interior, it is found in glues and resins used to manufacture furniture, composite wood, agrifibre products and laminated assemblies.

.17 HCFC: Hydrochlorofluorocarbon; a compound commonly used as refrigerant that is less environmentally damaging than CFC's but still contains ozone depleting substances.

.18 Indoor/Inside/Interior: within the building envelope's weatherproofing layer.

.19 LEED®: Leadership in Energy and Environmental Design. A voluntary, consensus-based, measurement system designed for rating new and existing buildings based on accepted energy and environmental principles. A performance system where credits are earned for satisfying criteria in seven categories of performance.

.20 LEED Material Divisions. Products in CSI MasterFormat 2004 Specification Divisions 03-10, 31, and 32 and mechanical insulation products in Division 22 and Division 23.

.21 LEED VOC Materials: Products containing volatile organic compounds applicable in all Specification Divisions for products used within the building.

.22 Low-Emitting Materials: Materials containing low amounts of volatile organic compounds.

.23 Material Cost: Includes billed cost for material, factory fabrication, overhead and labour, factory finishing, profit margin and delivery to site. Excludes on-site installation, finishing and labour associated with installation and finishing.

.24 Paints and Coatings: as defined in South Coast Air Quality Management District Rule 1113

.25 Post-Consumer Recycled Content: the percentage (by weight) of recycled material derived from previously used consumer products

.26 Product: permanently installed building product – an item that arrives on the project site either as a finished element ready for installation or as a component to another item assembled on site.

.27 Pre-Consumer Recycled Content: the percentage (by weight) of recycled material derived from outside industrial sources. In-house recycling of production scrap is not included. Examples: sawmill dust used in MDF, blast furnace slag used in mineral wool insulation, fly ash used in concrete mixes.

.28 Rapidly Renewable: materials that grow or regenerate in less than 10 years (e.g. wheat, straw, cork, bamboo, wool, jute, flax, etc.)

.29 Recycled Content: the percentage (by weight) of constituents recovered or otherwise diverted from the solid waste stream, either after manufacturing process (Pre-Consumer) or after consumer use (Post-Consumer).

.1 Manufacturer Recycled Content Claims must conform to the definition in ISO 14021-1999 Environmental Labels and Declarations, Self-Declared Environmental Claims (Type II Environmental labeling).

.30 Regional: Extracted, harvested, manufactured, distributed, and purchased within 160km of the project site.

.31 Sediment: Soil and other debris eroded and transported by wind, water or mechanical processes.

.32 Source: Location of extraction, manufacture and processing of a material.

.33 Volatile Organic Compound (VOC): organic chemicals that readily produce vapors at room temperature and normal atmospheric pressure. VOCs react with sunlight and nitrogen to form ground-level ozone, causing detrimental impact on human health, agricultural crops, soil, groundwater, plant life and ecosystems.

.34 Waste: Material that has reached the end of its useful life in its intended use. Waste includes trash, salvageable, returnable, recyclable, and reusable material.

.35 Waste Management Plan: A project-specific plan for the collection, transportation, diversion, recycling and disposal of waste generated at the construction site. The purpose of the plan is to appropriately manage and reduce the amount of material being land-filled.

.36 Wet Products: Materials and products installed in wet form

1.8 SUBMITTALS

.1 LEED Submittals must include, as specified for all LEED material divisions and LEED VOC material divisions complete, current, and accurate LEED product documentation as specified in the LEED Form(s) applicable to the material, component or product submitted:

.1 LEED Material Form: All products

.2 And as specified in Section 01 60 13 LEED Product Requirements and as specified in other Sections of the Specifications.

.3 Comply with requirements of Section 01 33 00 Submittal Procedures.

.4 LEED Submittals are in addition to other submittals. If a submitted LEED documentation item is identical to that submitted to comply with other requirements, note submittal as verification of compliance with the specific indicated LEED product requirements.

.5 Substitutions

.1 Materials and products have been selected to comply with requirements of the LEEDv4 Rating System and LEEDv4 Reference Guide. Substituted materials and products must meet or exceed LEED requirements for targeted Credits.

.2 Substitution requests must be accompanied by the appropriate LEED Form per article 2.1 for each substituted product.

.6 Provide on a monthly basis and prior to Substantial Performance of the Work a completed LEED BPDO Materials Calculator noting all contributing installed and approved products and materials.

.7 Provide on a month basis and prior to Substantial Performance of the Work a completed LEED Low Emitting Materials Calculator noting all contributing installed and approved products and materials.

.8 Final LEED Material Schedule: No later than 120 days prior to Substantial Completion or Interim Acceptance whichever occurs first the Contractor shall provide to the LEED Contract Administrator an updated electronic LEED Material Schedule indicating total construction costs for all LEED Materials and LEED Material Divisions and:

.1 A schedule of LEED Materials and Costs of all materials installed on the Project by specification Section and Subtrade. Exclude labour costs and mechanical and electrical material and labour costs.

.2 Identify for each material the post-consumer and pre-consumer recycled content as a percentage of the product cost and provide a summary of total combined recycled content value for all materials as a percentage of total LEED Materials costs.

.3 Identify for each material its total value of regional content as a percentage of total materials costs.

.4 Ensure all specified information is provided to the LEED Consultant including but not limited to Environmental Product Declaration, Health Product Declaration, Cradle to Cradle Certification, REACH Optimization, DECLARE label, GreenScreen Benchmark declaration Responsible Sourcing Report, Corporate Sustainability Report, Material Ingredient Report, Material Ingredient Optimization, Extended Producer Responsibility program, Supply Chain Optimization Report.

.9 Submit LEED information for all products a minimum thirty (30) days prior to start of Work of Subtrades affected by any LEED indoor air quality requirement and as specified in Section 01 81 19 LEED Indoor Air Quality Requirements.

.10 Submit for each LEED Material the LEED Forms in Section 01 35 40.01 with all fields and sections completed including all estimates of area, cost, and volume as applicable.

.1 LEED Material Form

.1 Submit compliant backup verifying VOC content for all adhesives, sealants, paints, and coatings including those used in floor systems, laminated wood products, and composite wood products and systems.

.2 Submit proof of emissions testing to California Department of Public Health Standard Method v1.2-2017.

.11 LEED Plans: Provide LEED Plans 30 days prior to date established for commencement of the Work indicating how the following requirements will be met:

.1 Waste Management Plan complying with Section 01 74 19 LEED Construction Waste Management and Disposal.

.2 Construction Indoor Air Quality Management Plan complying with Section 01 81 19 LEED Indoor Air Quality Requirements.

.3 Construction Activity Pollution Prevention Plan complying with Section 01 57 13 Erosion and Sedimentation Control.

.12 LEED Monitoring and Reporting:

.1 On a monthly basis Contractor shall provide to the LEED Consultant a complete and accurate status update of all related LEED Construction activities including:

.1 Completed weekly IAQ Inspection Forms

.2 Date Stamped Photographs of all IAQ (SMACNA) Controls

.3 Filter Log for all filters used on air handling equipment during construction listing type of filter, MERV rating, manufacturer, and model.

.4 Waste Tracking Summary and backup hauling tickets and invoices.

.5 ESC inspections and photographs of installed and decommissioned ES Controls.

.6 Updated list of installed building products.

.13 Provide LEED Submittals including but not limited to the scope of the Project:

.1 Manufacturer product data for interior and exterior lighting fixtures

.1 Include shop drawings with manufacturer's data on initial fixture lumens above 90° from nadir for all exterior lighting fixtures, and for parking lot lighting, verification of IESNA fixture classification as "full cutoff"

.2 Manufacturer product data for lighting controls systems components.

.3 Manufacturer product data for all lamps highlighting the mercury content

.4 Manufacturer product data for thermal comfort-control systems components.

.5 Manufacturer product data for temperature and humidity sensors and controls.

.6 Manufacturer product data for wall, ceiling, countertops, work surfaces, and floor finishes indicating Surface Reflectance for each material and finish.

.7 Manufacturer's shop drawings for temporary or permanent irrigation system.

.8 List of plant, turf, shrub, and tree species to be planted and of mulch and other ground cover material to be installed.

.9 Product data for plumbing fixtures and fittings indicating water consumption in litres per minute and maximum flow rates and/or flush rates.

.10 Product data for any automatic faucet-control devices.

.11 Product data for plumbing fixtures and fitting indicating WaterSense eligibility.

.12 Product data for all base building and non-base building HVAC and refrigeration system refrigerants and cooling capacities.

.13 Product data and Shop Drawings for carbon dioxide monitoring system

.14 Pre-Occupancy Indoor Air Quality Testing documentation:

.1 IAQ Testing Confirmation and IAQ Testing Report by a qualified professional per Section 01 81 19 LEED Indoor Air Quality Requirements.

.15 Manufacturer product data for entryway and walk-off systems.

.16 Complete LEED Forms through LEED Online for each targeted LEED Construction Credit.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Prevent accumulation of moisture on materials and within packaging during delivery, storage, and handling to prevent development of mold and mildew on packaging and products. Comply with all requirements of Section 01 81 19 LEED Indoor Air Quality Requirements.

.2 Packaging:

.1 Comply with all requirements of Section 01 74 19 LEED Construction Waste Management and Disposal.

.2 Ensure protection of materials during delivery, storage and handling.

.3 Where pallets are used, ensure pallets are removed from site for reuse or recycling.

1.10 RESPONSIBILITIES

.1 Contractor will employ a LEED Designate to oversee the LEED process, manage documentation and submittals, and to provide support to Contract Administrator and Subcontractors.

.2 Contractor will recognize the LEED Credits to be achieved and determine compliance mechanisms and procedures for achievement.

.3 It is the Contractors responsibility to ensure all materials, products, and procedures comply with project LEED requirements. Work found to be in conflict with these requirements will be made good at the Contractor's expense.

.4 Where conflict occurs, the LEEDv4 Rating System and referenced documents will take precedence over these Specifications.

.5 All personnel must undertake a LEED Orientation before working on site, to be provided by the Contractor's qualified and designated party.

.6 Contractor will attend all meetings required for LEED coordination.

.7 Contractor shall not rely on compliance based on previous projects as acceptance for this Project.

.8 Contractor will coordinate with LEED Consultant, Commissioning Consultant and Contract Administrator and subcontractors to meet LEED compliance and execute requirements in accordance with targeted LEED Credits.

.1 Contractor must participate in Commissioning as specified by the Commissioning Consultant and provide Submittals as outlined in the Commissioning Plan.

.9 Contractor will coordinate and allow access for site visits, inspections, testing and evaluations with other parties as required to meet LEED compliance and execute LEED requirements in accordance with targeted LEED Credits, including but not limited to:

.1 Commissioning

.2 Indoor Air Quality Testing

.3 Construction Activity Pollution Prevention (ESC Plan)

.4 Construction and Demolition Waste Management (CWM Plan)

.5 Indoor Air Quality Management Plan (IAQ Plan)

.6 Acoustics Testing and Assessment

.7 Manual Daylight Assessment

.8 Building Envelope Inspections, Testing, Assessment

1.11 PAYMENT PROCEDURES

.1 The Contract Administrator may withhold or nullify the whole or a part of any application for payment represented by the Contractor's estimate, or a Certificate of Payment to such extent as may be necessary to protect the City from loss because of unsatisfactory documentation of LEED Materials and procedures by the Contractor and/or the Subcontractors.

1.12 DOCUMENTATION

.1 All parties are required to submit required LEED documentation, support material and any additional information requested in a timely manner as requested at no additional cost.

2 Products

NOT USED

3 Execution

NOT USED

END OF SECTION

LEEDv4 Materials Form

PROJECT:				SUBCONTRACTOR:	
WORK SCOPE / DIVISION:				CONTACT NAME:	
DATE:		PHONE:		EMAIL:	

See Specification for LEED requirements and definitions

Form to be completed and submitted with backup information. Attach documentation to support all values and "YES" columns in table

Manufacturer	Product Name + Application	Estimated Material Value[1]	Backup[2] (Y/N)	Recycled Content[3]		Local Product[4] (Y/N)	% Biobased Material[5]	EPD[6] (Y/N)	LCA[7] (Y/N)	CSR[8] (Y/N)	Material Ingredient Report[9] (Y/N)	VOC Emitting (Y/N)	VOC Emissions Certification Program[10] (Y/N)
				% Pre	% Post								

Notes:

1. Total material cost EXCLUDING delivery + installation
2. Provide BACKUP documentation from MANUFACTURER to verify information provided
3. Pre and Post-Consumer recycled content **%** provided by the MANUFACTURER
4. Local Products: EXTRACTION, MANUFACTURE, PURCHASE and DISTRIBUTION within **160 km** radius of PROJECT SITE
5. Bio-based materials: contain biological or renewable agricultural materials (plant and animal, EXCLUDING leather products)
6. Environmental Product Declaration (EPD)
7. Life Cycle Assessment (LCA)
8. Corporate Sustainability Report (CSR)
9. Acceptable Material Ingredient Reports: Manufacturer's Inventory, Health Product Declaration, Cradle to Cradle, Declare Label, UL Product Lens
10. Acceptable Certification Programs: CDPH, GreenGuard Gold, FloorScore, SCS Indoor Advantage Gold, Other USGBC Approved Third Party

1 General

1.1 DEFINITIONS

.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.2 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit Environmental Protection Plan (EPP) for review before delivering materials to site or commencing construction activities.

.1 Include comprehensive overview of known or potential environmental issues to be addressed on site during construction.

.2 Address topics at level of detail commensurate with environmental issue and required construction task.

.3 Have EPP available for inspection by the City and regulatory agency personnel and post at conspicuous locations throughout the Work Site.

.4 Include in Environmental Protection Plan (EPP):

.1 Name of person responsible for ensuring adherence to EPP.

.2 Name and qualifications of person responsible for manifesting hazardous waste to be removed from site.

.3 Name and qualifications of person responsible for training site personnel.

.4 Descriptions of environmental protection personnel training program.

.5 Submit a Contractor developed Soil Management Plan (SMP) including soil excavation and backfilling plan for the various material types, confirmed size and location of any temporary soil containment cells, and stockpiling plan including the following:

.1 Section 6 Proposed Remedial Actions as reference in Appendix D1, City of Winnipeg North Transit Garage Replacement Design Remedial Plan, February 2025 (Appendix 1).

.2 Debris (concrete, metal) encountered during excavation in the landfill must be separated, cleaned of soil and disposed of at an appropriate landfill or facility or within the berm. Waste (manmade, non-soil, non-inert material) encountered in the landfill will be hauled offsite to an approved landfill. It is assumed that waste with soil from within the landfill footprint is impacted.

.3 A pre-construction soil sampling program will be conducted across the Site by AECOM to determine impacted and non-impacted soil boundaries. Based on the laboratory results, the site will be divided into sections. Impacted soil (other than PHC/PAH impacted soil) will be disposed of at either the onsite berm, offsite at a facility that accepts contaminated soil or in an onsite location that will be covered with a cap (i.e. clay, asphalt or concrete). Non-impacted soil will be disposed at a City facility for industrial and commercial use, at a commercial landfill or

used as the site-wide clay cap. The Contract Administrator will direct the destination of the excavated soil.

.4 PHC/PAH impacted soil will be disposed at a licensed soil disposal facility that accepts contaminated soil.

.5 Contractor is solely responsible for the coordination and selection of the licenced soil disposal select site. Preliminary discussion with Prairie Green Landfill indicated non-impacted fill can be accepted at no cost (i.e. no tipping fee) as long as the contaminated soil is disposed of at their facility. The Contractor will need to confirm this with Prairie Green and receive approval for disposal.

.1 If the licenced soil disposal site restricts soil disposal for any reason, the Contractor shall bear all costs associated with the coordination and selection of another licenced soil disposal site.

.2 Contractor shall make itself aware of current proposed searches that may, or may not, impact selected disposal sites' ability to receive materials.

.3 Non-impacted soil should be disposed of at a City-owned property for commercial or industrial use only or to a landfill for use at the landfill facility. The Contractor must submit a proposed clean fill soil disposal location for the Contractor Administrator's approval and must include written acceptance of the soil.

.6 Submit a Contractor developed site-specific Stormwater Pollution Prevention Plan (SPPP) in accordance with EPA-833-R-06-004. Include the site-specific Erosion and Sediment Control Plan (ESCP) identifying the type and location of erosion and sediment control measures to be provided on site. Include monitoring and reporting requirements to confirm that erosion and sediment control measures are in compliance with the ESCP, Federal and Provincial regulations, and Municipal by-laws.

.7 Refer to E14 Erosion Control Blanket and E15 Silt Fence and include measures to reduce erosion of temporary and existing roadbeds by construction traffic, especially during wet weather.

.1 Traffic Control Plan (TCP) to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff, including truck wash stations if required or other measures or practices to prevent inadvertent spread of impacted soils during construction.

.8 Submit a Contractor developed Site Work Plan (SWP) showing work areas for proposed activities in each portion of area and identifying areas of limited use or non-use.

.1 SWP to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.

.2 Submit drawings indicating locations of proposed temporary excavations or embankments for haul roads, ditch crossings, material and equipment staging areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on Site.

.9 Submit a Contractor developed Spill Control Plan (SCP) including procedures, instructions, and reports to be used in the event of an unforeseen spill of regulated substances. Typically, the plan shall include:

.1 The probability and severity of an adverse effect to health, property, or the environment, of a spill of sewage, chlorinated water, or hazardous materials, used, handled, or stored on the Work Site,

.2 Spill/release notification and alerting procedures,

.3 Spill containment, recovery, and clean-up procedures,

.4 On Site spill/release clean-up materials, equipment, and locations;

.5 Names and telephone numbers of persons and organizations that may be contacted in the event of a potential environmental incident;

.6 The Contractor shall maintain a readily available supply of spill prevention and emergency response equipment on the Work Site at all times in effective working condition and shall ensure that its personnel are adequately trained in its use to deal with environmental emergency situations;

.7 In the event of an environmental emergency, the Contractor shall immediately notify the Contract Administrator. If the environmental emergency is a spill to land of a hazardous material in quantities equal to or greater than those listed in the Environmental Accident Reporting Regulation under the Dangerous Goods Handling and Transportation Act, the Contractor shall immediately notify the Provincial Emergency Reporting Line at 204 944-4888; and

.8 The Contractor shall submit written incident reports to the Contract Administrator within 24 hours of any environmental incident or spill/release. The incident report shall identify the reporting organization, date, time, location, hazardous materials involved, source and persons or organizations notified. In addition, the report shall describe how the spill or release occurred, remedial action taken or planned, and actions necessary to prevent recurrence.

.10 Submit a Contractor developed Solid Waste Disposal Plan (SWDP) for non-hazardous solid wastes identifying methods and locations for solid waste disposal including clearing debris from the Site and former Brooklands Landfill. Reference Section 6.2.3.1, 6.2.3.4 and 6.2.4 of the Remedial Plan, February 2025 (Appendix 1).

.1 Any waste (manmade, non-soil, non-inert material) encountered during excavations from the landfill will be hauled offsite to an approved landfill. It is assumed that waste with soil from within the landfill footprint is impacted.

.2 Contractor to identify sorting requirements as required by the destination landfill – painted vs non painted wood, treated wood, concrete and concrete with rebar, and metallic waste. Material should be recycled where feasible.

.3 The Contract Administrator will provide direction if material needs to be segregated for sampling to confirm disposal method, such as, hazardous waste.

.4 Oversaturated materials may need to be dried before trucking offsite for disposal, dependent on offsite facility acceptance criteria.

.11 Submit a Contractor developed Air Pollution Control Plan (APCP) detailing provisions to suppress dust and contain debris, materials, and trash within the project Site. Further measures could include the covering of any stockpiles with loose or dry material and the wetting of exposed soils that are generating dust.

.12 Submit a Contractor developed site-specific Contaminant Prevention Plan (CPP) identifying the proper procedures and actions to be implemented to prevent impacts due to the presence of any hazardous substances within the project Site. The intent of the CPP is to:

.1 Prevent introduction of hazardous substances into air, water, or ground; and

.2 Detail provisions for storage and handling of these materials in compliance with Federal, Provincial, and Municipal laws.

.13 Submit a Contractor developed Wastewater Management Plan (WMP) identifying methods and procedures for management and discharge of waste waters which are directly derived from construction activities, such as clean-up water, dewatering of groundwater, decontamination water, and water collected in containment berms. Reference Section 6.2.8 of the Remedial Plan (Appendix 1).

1.3 FIRES

.1 Fires and burning of rubbish on site is not permitted.

.2 Submit a Contractor developed Fire Safety Plan to the Contract Administrator with details as identified in the National Fire Code of Canada 2020 for Construction and Demolition Sites.

.3 Where fires or burning is permitted, prevent staining or smoke damage to structures, materials or vegetation which is to be preserved.

.1 Restore, clean and return to new condition stained or damaged work.

.4 Provide supervision, attendance and fire protection measures as directed.

1.4 CONTRACTOR ENVIRONMENTAL REPRESENTATIVE

.1 The Contractor shall designate a Contractor Environmental Representative (CER) to perform environmental monitoring and reporting throughout construction according to the EPP. The CER will interact with the project team throughout the Work.

.2 The CER shall be adequately trained and experienced to perform the role according to the requirements of the EPP.

.3 The CER shall represent the Contractor and information and instructions given to the CER by the Contract Administrator shall be deemed to have been given to the Contractor.

.4 The Contractor shall not claim for delays for any the activities, findings or requirements set forth by the CER in the performance of their duties toward Environmental Monitoring nor those of the Contract Administrator as a result of inspections.

.5 The Contractor is responsible for all costs relating to the CER for the entire duration of the project. This is not expected to be a full time role but is needed for the Contractor to meet the Contractual and regulatory obligations related to environmental protection.

1.5 PRE-CONSTRUCTION PROCEDURES

.1 Pre-Construction procedures shall be followed for wildlife species:

.1 The Site shall be cleared of natural vegetation and grubbed prior to construction outside of the breeding bird season for Winnipeg (April 30 – August 18) to prevent birds from establishing nests in vegetation on or above ground, to minimize adverse impacts on other wildlife species during the breeding season, and to avoid contravening wildlife protection legislation. Vegetation regrowth must be controlled (e.g., weekly mowing of grassy areas) throughout the breeding bird nesting season to prevent bird nesting activities.

.2 Pre-Clearing - Wildlife Species with Activity Restrictions:

.1 The CER shall locate, identify, classify and report wildlife species requiring activity restrictions discovered within and adjacent to the site during pre-clearing and the Contractor shall report to the Contract Administrator.

.2 The Contractor shall review, with the CER and Contract Administrator the wildlife species encountered and take reasonable measures, at Contractor's expense, to schedule activities outside of any timing restrictions and distance restrictions.

.3 The validity of the pre-clearing exercise is dependent on the time from when the pre-clearing is conducted to commencement of the related construction activity and thus must be coordinated with the Contractor Progress Schedule.

.4 The Contractor shall coordinate pre-clearing activities with the progress schedule, so that pre-clearing is conducted and coordinated with the Contractor's planned activities.

.5 Bird Nests:

.1 No bird nests shall be disturbed during the construction process.

.2 If a bird nest is encountered in conflict with any construction activity, a mitigation strategy to avoid impact to the nest must be developed in consultation with the City and the Contract Administrator, Manitoba Environment and Climate and the federal Department of Environment and Climate Change Canada which may include postponing work within a no-activity buffer area until fledgling young have left the area, and/or the nest is no longer active.

1.6 SITE PREPARATION AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties in accordance with the City of Winnipeg By-laws, Standard Construction Specifications and the Work Drawings and Specifications.

.2 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.

.3 Minimize vegetation stripping and grubbing where not necessary. Minimize soil removal and stockpiling.

1.7 DRAINAGE

.1 Ensure that the ESCP measures are provided and that its recommendations are followed on site, in accordance with the site-specific SPPP, at all times during construction.

.2 Contractor to collect required water samples for laboratory analysis and obtain necessary approvals from the City of Winnipeg for sanitary or storm discharges.

.3 Provide temporary drainage and pumping as required to keep excavations on site free of standing water.

.4 Do not pump water containing excessive suspended materials into storm sewers, wetlands, waterways, surface drainage runs or adjacent properties.

.5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with the site-specific SPPP in compliance with the requirements of authorities having jurisdiction.

1.8 SITE CLEARING AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties in accordance with the Canadian Landscape Standard -First Edition, Section 03 - Site Preparation and Protection of Existing Site Elements.

.2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of two meter minimum. Ensure that control measures used for protection are in compliance with local authorities having jurisdiction laws and regulations.

.3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.

.1 Avoid unnecessary traffic, dumping and storage of materials over root zones.

.4 Minimize stripping of topsoil and vegetation.

.5 Restrict tree removal to areas. Obtain permits before trees removal in accordance with the requirements of the authorities having jurisdiction.

1.9 WORK ADJACENT TO WATERWAYS

.1 Construction equipment to be operated on land only.

.2 Limit the use of waterway beds for borrow material only after written receipt of approval from Contract Administrator.

.1 Avoid indicated spawning beds when constructing temporary crossings of waterways.

.3 Keep waterways free of excavated fill, waste material and debris.

.4 Design and construct temporary crossings to minimize waterways erosion.

.5 Do not skid logs or construction materials across waterways.

1.10 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this Contract in accordance with site-specific SPPP.

.2 Control emissions from equipment and plant in accordance with local authorities' emission requirements. Check with local authorities for any environmental compliance requirements.

.3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.

.4 Provide temporary enclosures where indicated.

.5 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

.6 Tightly seal against corrosion and rust, all containers of fuel, hazardous or toxic chemicals. Tanks for refueling should have secondary containment and be licensed with the Province of Manitoba.

.7 Vehicle and equipment maintenance shall occur in designated areas. Contain and handle all maintenance fluids in accordance with the current National Fire Code of Canada. Spillage on the

ground is prohibited. Any spills to be addressed in accordance with Section 1.3.9 and the site-specific SCP.

.8 Hoses and equipment for transfer of fuels and other hazardous fluids shall be in good condition, properly functioning with approved check valves and shall be attended by a qualified person for the duration of transfer of fuels or hazardous fluids. Do not fuel, lubricate or service equipment where spills may enter storm or sanitary sewer systems.

.9 Greasy and oily rags and oil waste shall be contained in approved, sealed containers. Remove from the work Site and dispose of this material in accordance with the most stringent of applicable Federal, Provincial and Municipal Regulations.

.10 Comply with any Local, Provincial or Federal Noise By-laws or Regulations.

.11 Discharge of water containing any chlorine residual into open drainage channels, including the City's storm sewer system, is strictly prohibited.

1.11 NOTIFICATION

.1 Contract Administrator will notify the Contractor in writing of observed noncompliance with Federal, Provincial environmental laws and regulations or Municipal environmental by-laws, permits, and other elements of site-specific plans.

.2 Contractor, after receipt of such notice, shall inform the Contract Administrator of proposed corrective action and take such action to obtain the approval of the Contract Administrator.

.3 Take action only after receipt of written approval by the Contract Administrator.

.4 Contract Administrator will issue stop order of Work until satisfactory corrective action has been implemented.

.5 No time extensions granted, or equitable adjustments will be allowed to the Contractor for such suspensions.

2 Products

Not Used

3 Execution

3.1 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00.

.2 Clean in accordance with Section 01 74 00 Cleaning and Waste Processing.

.3 Leave Work area clean at end of each day.

.4 Bury rubbish and waste materials on site is nor permitted.

.5 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

.6 Proceed with final cleaning upon completion and removal of surplus materials, rubbish, tools and equipment.

.7 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00.

.8 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 Testing and inspecting services are required to verify compliance with specified requirements. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

.1 Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of products.

.2 Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality control procedures that facilitate compliance with the Contract Document requirements.

.3 Requirements for Contractor to provide quality assurance and quality control services required by Contract Administrator, the City, or authorities having jurisdiction are not limited by provisions of this Section.

.2 Travel Expenses: Where it is necessary for the Contract Administrator and the City to visit places away from the Place of the Work in order to supervise, inspect or witness testing activities of items of the Work, for compliance with the Contract Documents, the Contractor shall pay the travelling, lodging and food expenses of Contract Administrator and the City.

.3 Conflicting Requirements: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Contract Administrator for a decision before proceeding.

1.2 DEFINITIONS

.1 Quality Assurance: Activities, actions, and procedures performed before execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

.2 Quality Control: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Contract Administrator.

.3 Sample Installations: Full-size, physical assemblies that are constructed on-site. Sample installations are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved sample installations establish the standard by which the Work will be judged.

.4 Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

.5 Testing Agency: An independent agency engaged to perform specific tests, inspections, or both.

.6 Experienced: An entity having successfully completed previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 QUALITY ASSURANCE

.1 General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

.2 Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

.3 Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

.4 Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

.5 Professional Engineer Qualifications (Contractor's Engineer): A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

.6 Specialists: Contract Documents may require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated. Requirement for specialists shall not supersede requirements of authorities having jurisdiction.

.7 Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated, and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

.8 Manufacturer's Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

.9 Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

.1 Contractor responsibilities include the following:

.1 Provide test specimens representative of proposed products and construction.

.2 Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

.3 Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.

.4 Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.

.5 Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.

.6 When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

.2 Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Contract Administrator with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.4 QUALITY CONTROL – TESTING

.1 General: The City may require, during progress of the Work, testing and inspection by an independent testing company as directed by the Contract Administrator, or as required in Contract Documents, to determine if Work meets the specified requirements.

.1 The City will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.

.2 If upon examination work is found in non-conformance to Contract Documents, Contractor shall correct such Work and pay cost of retesting and reinspection.

.3 If such Work is found in conformance to Contract Documents, the City shall pay cost of examination and replacement.

.4 Cost of services will be paid by the City.

.5 Cost of services will be paid out of cash allowance. Pay testing agency charges authorized by the Contract Administrator from the cash allowance included for these services.

.6 Retesting and Reinspection: When initial tests indicate non-compliance with the Contract Documents, costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be the responsibility of the Contractor. Retesting and reinspection shall be performed by the same testing agency as the initial tests.

.7 If Contractor covers or permits to be covered Work that has been designated for tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.2 Testing Agency Responsibilities

.1 Cooperate with Contract Administrator and Contractor in performance of duties. Provide qualified personnel and equipment to perform required tests and inspections.

.2 Notify Contract Administrator and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.

.3 Determine the location from which test samples will be taken and in which in-situ tests are conducted.

.4 Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

.5 Submit certified written report, in triplicate, of each test, inspection, and similar quality-control service to the Contract Administrator.

.6 Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

.7 Do not perform any duties of Contractor.

.3 Contractor Responsibilities

.1 Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

.1 Access to the Work.

.2 Incidental labour and facilities necessary to facilitate tests and inspections.

.3 Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.

.4 Facilities for storage and field curing of test samples.

.5 Delivery of samples to testing agencies.

.6 Preliminary design mix proposed for use for material mixes that require control by testing agency.

.7 Security and protection for samples and for testing and inspecting equipment at Project site.

.2 Coordination: Coordinate sequence of activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

.1 Schedule times for tests, inspections, obtaining samples, and similar activities.

.3 Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality assurance and quality control services required. Submit schedule within (30) days of date established for commencement of the Work.

.1 Distribution: Distribute schedule to the City, Contract Administrator, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

.2 Establishing Schedule: Determine the time required for the agencies to perform their duties and the time required for the issuance of resulting reports. Allow for the times in the construction schedule.

.3 Schedule Revisions: Co-ordinate revisions with the testing and inspection agencies when changes to the construction schedule are necessary.

.4 Schedule Adherence: Provide advance notice to the testing laboratory and to the inspection company of when testing of the Work is required. If the testing laboratory is ready to perform its functions according to the schedule and is prevented from doing so due to incompleteness of the work, extra costs for testing attributable to the delay will be back charged to the Contractor.

1.5 QUALITY CONTROL - CODE AND CONTRACT COMPLIANCE, AND CONTRACTOR'S CONVENIENCE TESTING

.1 Code Compliance Testing: Inspection and tests required by codes or ordinances, or by an authority having jurisdiction shall be the responsibility of the Contractor and shall be paid for by the Contractor.

.2 Contract Compliance Testing: Inspection and tests required by Contract Documents shall be the responsibility of the Contractor and shall be paid for by the Contractor. These services include and not limited to the following:

.1 Mill Tests.

.2 Mix Designs.

.3 Building Systems Performance, Adjustments and Balancing Reports.

.3 Contractor's Convenience Testing: Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor and paid for by Contractor as part of the Contractor.

.4 Engage a qualified testing agency to perform these quality-control services. Contractor shall not employ same entity engaged by the City, unless agreed to in writing by the City.

.5 Submit a certified written report, in triplicate, of each quality-control service.

.6 Submit additional copies of each written code compliance report directly to authorities having jurisdiction, when they so direct.

.7 Retesting/Reinspecting: Provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with code requirements and Contract Documents. Retesting and reinspection shall be performed by the same testing agency as the initial tests. Retesting/reinspecting costs shall be borne by the Contractor.

.8 Manufacturer's Field Services: Where indicated, engage a factory authorized service representative to inspect field-assembled components and equipment installation, including service connections.

1.6 SAMPLE INSTALLATIONS

.1 Construct sample installations for Work specifically requested in specifications. Include for Work of all Sections required to provide sample, installations. Obtain Contract Administrator's approval of sample installations before starting work, fabrication, or construction.

.2 Construct in locations acceptable to Contract Administrator with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.

.3 Failure to construct sample installations in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.4 If requested, Contract Administrator will assist in preparing a schedule fixing dates for sample installation construction.

.5 Maintain sample installations during construction in an undisturbed condition as a standard for judging the completed Work.

.6 Specification Sections identify whether sample installations may remain as part of Work or to be removed.

2 Products

2.1 TEST AND INSPECTION LOG

.1 Prepare a record of tests and inspections. Include the following:

.1 Date test or inspection was conducted.

.2 Description of the Work tested or inspected.

.3 Date test or inspection results were transmitted to Contract Administrator.

.4 Identification of testing agency or special inspector conducting test or inspection.

.2 Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Contract Administrator's reference during normal working hours.

3 Execution

3.1 REPAIR AND PROTECTION

.1 On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

.2 Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

.3 Protect construction exposed by or for quality-control service activities.

.4 Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

3.2 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Contract Administrator as failing to conform to Contract Documents. Replace in accordance with Contract Documents at the cost of the Contractor.

.2 Make good other contractor's work damaged by such removals or replacements promptly.

.3 If in opinion of Contract Administrator, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, the City may deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Contract Administrator.

END OF SECTION

1 General

1.1 AUTHORITIES HAVING JURISDICTION

.1 Where reference is made to "authorities having jurisdiction" (AHJ), it shall mean all authorities who have within their constituted powers the right to enforce the laws of the place of the building.

1.2 DEFINITIONS

.1 The "Constructor" named in the latest addition of The Occupational Health and Safety Act, and the Workplace Safety and Insurance Board (WSIB) Regulations, of the Province of the place of the Work, including any amendments, shall mean the "Contractor" for the work performed under this Specification.

1.3 FIRE PREVENTION AND SAFETY

.1 Enforce fire protection methods, good housekeeping, and adherence to local and underwriter's fire regulations. Provide ULC approved fire extinguishers, and other fire fighting services and equipment except where more explicit requirements are specified as the responsibility of individual Sections.

.2 Maintain clear emergency exit paths for personnel at all times.

.3 Use only fire resistant tarpaulins and similar protective covering on site.

1.4 FIRE PROTECTION OF STRUCTURE

.1 Ensure that nothing subverts the integrity of fire protection provided for the building structure.

.2 Provide fire protection of structural members for their entire length and girth.

.3 Coordinate work of all Sections so that they do not encroach on space required for fire protection and its installation. Ensure that fire protection damaged during construction is totally replaced.

1.5 FIRE SEPARATIONS

.1 Ensure that fire separations are installed to maintain total integrity and that they are not diminished or breached by work following their installation.

.2 Replace fire separations which have suffered a lessening of their required rating during construction.

1.6 WASTE MANAGEMENT

.1 Comply with all applicable regulations and requirements of the place of the Work. Waste Audits and Waste Reduction Workplans, Industrial, Commercial and Institutional Source Separation Programs under the Environmental Protection Act of the place of the Work, including preparing and submitting waste audit and reduction plan specified in Section 01 74 00 Cleaning and Waste Processing.

1.7 ENERGY EFFICIENCY

.1 The building has been designed and will be constructed by the Contractor to high quality engineering practice as described in ASHRAE/IES 90.1, "Energy Efficient Design of New Buildings Except Low-rise Residential Buildings" as interpreted by the "Guidelines for the Interpretation of ASHRAE/IES 90.1".

1.8 REQUIREMENTS OF REGULATORY AGENCIES

.1 Work shall include protection measures consisting of materials constructions and methods, and first-aid equipment and personnel, required by the latest edition of The Workplace Safety and Health Act, and the Workplace Safety and Health Regulations, of the Province of Manitoba, and as otherwise imposed by authorities having jurisdiction to save persons and property from harm.

.2 Ensure that pollution, noise pollution and environmental control of construction activities are exercised as required during the work.

.3 Except where special permission is obtained, maintain clear access for roads and sidewalks on public property.

.4 Maintain all (Municipal and Provincial) roads and sidewalks clear of construction materials and debris, including excavated material. Clean roads and sidewalks as frequently as required to ensure that they are cleared of materials, debris and excavated material.

.5 Remove snow and ice from sidewalks as required and to the standards acceptable by the Municipality.

1.9 REFERENCE STANDARDS

.1 Where edition date is not specified, consider that references to manufacturer's and, published codes, standards and specifications are made to the latest edition (revision) approved by the issuing organization, current at the date of this Specification.

.2 Reference standards and specifications are quoted in this Specification to establish minimum standards. Work of quality or of performance characteristics that exceeds these minimum standards will be considered to conform.

.3 Should the Contract Documents conflict with specified reference standards or specification, the General Conditions of the Contract shall govern.

.4 Where reference is made to manufacturer's directions, instructions or specifications they shall include full information or storing, handling, preparing, mixing, installing, erecting, applying, or other matters concerning the materials pertinent to their use and their relationship to materials with which they are incorporated.

.5 Have a copy of each code, standard and specification, and manufacturer's directions, instructions and specifications, to which reference is made in the Specifications, always available at construction site.

.6 Standards, specifications, associations, and regulatory bodies are generally referred to throughout the specifications by their abbreviated designations. These are as follows:

AA	The Aluminum Association
AAMA	American Architectural Manufacturer's Association (USA)
ACI	American Concrete Institute
AISI	American Iron and Steel Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWMAC	Architectural Woodwork Manufacturers Association of Canada
AWS	American Welding Society (USA)
CGSB	Canadian General Standards Board
CISC	Canadian Institute of Steel Construction
CLA	Canadian Lumbermans' Association
CPMA	Canadian Paint Manufacturers Association
CRCA	Canadian Roofing Contractors Association
CSA	Canadian Standards Association
CSSBI	Canadian Sheet Steel Building Institute
FM	Factory Mutual
GANA	Glass Association of North America
MPI	Master Painters Institute
MTO	Ministry of Transportation and Infrastructure of Manitoba
NAAMM	National Association of Architectural Metal Manufacturer's
NBC	National Building Code
NEMA	National Electrical Manufacturer's Association
NFC	National Fire Code of Canada
NFPA	National Fire Protection Association (USA)

NHLA National Hardwood Lumber Association
NLGA National Lumber Grades Authority
NRC National Research Council
MAA Manitoba Association of Architects
MBC Manitoba Building Code
MR 82/2023 The Manitoba Fire Code
WCA Winnipeg Construction Association
Winnipeg Standard Construction Specifications
RCAM Roofing Contractors Association of Manitoba
PEI Porcelain Enamel Institute
SAE Society of Automotive Engineers
SJI Steel Joist Institute
SSPC Steel Structures Painting Council
TTMAC Terrazzo, Tile and Marble Association of Canada
ULC Underwriters Laboratories of Canada
ULI Underwriters Laboratories Incorporated (USA)

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 Permits: Be responsible for arranging, obtaining and paying for any permit necessary for temporary facilities and controls.

.2 Provide, maintain and pay for all temporary facilities and controls. Remove them when directed or when no longer required.

.3 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by the Construction Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.

.4 Provide exterior stair/landing in galvanized steel or aluminum serrated grating with galvanized steel or aluminum guardrail and handrail

.5 Identify areas which have to be gravelled to prevent tracking of mud.

.6 Indicate use of supplemental or other staging area.

.7 Provide construction facilities in order to execute work expeditiously.

.8 Remove from Site all such Work after use.

1.2 SAFETY PROGRAM

.1 Be responsible to provide full safety program for workers including management, labour, delivery drivers, service personnel and others involved for services on site. Arrange for pre-project meeting related to safety, joint safety inspections, site safety training and safety committees complete with accident investigation procedures.

.2 Prior to commencement of execution of Work, design fire safety plan in conjunction with local Fire Chief. Post fire plan throughout the Work. Do not allow accumulation of waste that may constitute fire hazard.

.3 Comply with requirements of Acts and Regulations with respect to health and safety. Before commencement of Work, and throughout Contract, maintain on site, and readily accessible to all those who may be exposed to hazardous materials, list of hazardous materials proposed for use on Site or Workplace together with current Materials Safety Data Sheet (MSDS).

.4 Ensure hazardous materials used and/or supplied on site are labelled in accordance with WHMIS requirements. Provide detailed written procedures for safe handling, storage and use of such hazardous materials including special precautions, safe clean up and disposal procedures. Conform to Environmental Protection Act for disposal requirements.

.5 Ensure that those who handle, and/or are exposed to, or are likely to handle or be exposed to, hazardous materials are fully instructed and trained in accordance with WHMIS requirements.

.6 Watch work area in accordance with CSA W117.2 – Safety in Welding, Cutting and Allied Processes after hot work is completed. Provide Site fire security when required by local building department and/or municipal fire department. Ensure that water supply is adequate for firefighting.

.1 Submit sample of Hot Work Permit to the Contract Administrator in accordance with Section 01 33 00 – Submittal Procedure:

.1 Hot Work Permit shall be in accordance with CSA W117.2 – Safety in Welding, Cutting and Allied Processes.

.7 Provide and maintain in working order, suitable Underwriters' labelled fire extinguishers and locate in suitable positions, to approval of authorities having jurisdiction. Such extinguishers shall be maintained to requirements of ULC.

.8 Store all rags and waste containing oil, grease or other flammable materials in an approved metal container and remove from Site at end of each working day.

.9 Only fire-resistant tarpaulins are permitted on Site.

.10 Notify Fire Department and Contract Administrator immediately should a fire of any nature occur whether fire has been extinguished or not.

.11 If any claim is made by anyone against Contractor or any Subcontractor on account of any accident or damage, promptly report facts in writing to the Contract Administrator, giving full details of claim.

1.3 SECURITY

.1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

.2 Maintain a secure Site, with fencing and lockable gate.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit shop drawings for but not limited to the following items:

.1 Temporary offices and temporary offices anchorage to grade.

.2 Temporary storage shed(s) and shed(s) anchorage to grade.

.3 Construction aids equipment.

.4 Construction signage.

.5 Temporary electrical and mechanical systems.

.6 Includes information in the shop drawings but not limited to the followings:

.1 Codes used as basis for design.

.2 Design loads (as applicable).

.3 Material requirements.

.4 Details necessary to describe the Work.

.5 Connection and anchorage details.

.6 Plan and section views.

.7 Work required to restore existing finishes.

.7 Retain a Professional Engineer (Contractor’s Professional Engineer), licensed in the Province of the Project, experienced in performing design, inspection, and installation certification services work of comparable complexity and scope to perform the following services:

.1 Design of structural members and connections.

.2 Design temporary offices and storage sheds anchorage to grade in accordance with the current National Building Code.

.3 Review, stamp, and sign Shop Drawings, design calculations, and amendments.

.4 Inspection and installation certification.

.1 Submit the Contractor's Professional Engineer site review report noting compliance to the Contractor's Professional Engineer's design documents.

2 Products

2.1 TEMPORARY FIELD OFFICES AND STORAGE SHEDS

.1 Contract Administrator Office:

.1 Provide for the sole use of the Contract Administrator, a Contract Administrator trailer with manufacturing date no later than 2022.

.2 Supply and maintain a trailer, satisfactory to the Contract Administrator, for the exclusive use of the Contract Administrator for the duration of the Contract until at least three (3) months following Substantial Performance.

.3 Trailer to consist of a minimum of the following rooms inside the trailer:

.1 Office for Contract Administrator with own door with lock and key.

.2 Meeting Room (open space) to fit a minimum of fifteen (15) chairs and persons.

.3 Washroom (Universal).

.4 The trailer to be set up in approved location within fourteen (14) days of Notice to Proceed or actual work commencement whichever occurs first. Failure to comply will result in the City providing the required office and back charging the Contractor.

.5 Locate the trailer within the work area as directed by the Contract Administrator, physically separated from any other structure.

.6 Make all necessary applications, obtain permits and pay for all fees, charges for service and use.

.7 Provide and pay for all temporary telephone, potable water, power, heating, air-conditioning, high-speed internet equipment and services and lighting required during construction.

.8 Provide a windproof, weather tight structure at least 300 mm above ground level and having a floor area of not less than 48.3 m^2 and 2.6 m ceiling height.

.9 Equip office with:

.1 One (1) new standard office desk having three lockable drawers.

.2 One (1) new swivel type office chair with adequate ergonomic and lumbar support.

.3 One (1) standard four drawer, legal-size, lockable, steel filing cabinet with three (3) sets of keys.

.4 One (1), three tier wooden bookcase.

.5 Unlimited high speed internet connection from independent telephone line, including Wi-Fi internet service.

.6 One (1) garbage bin.

.7 One (1) recycling bin.

.8 One (1) 610mm x 910mm whiteboard with one (1) set of dry erase markers and erasers. Contractor shall install at the location specified by the Contract Administrator.

.9 One (1) 610mm x 910mm cork board with pins. Contractor shall install at the location specified by the Contract Administrator.

.10 Equip meeting room with:

.1 layout table fabricated from 19mm thick new plywood Good One Side (nominal size1200x2400mm) and minimum 38x89mm material with one 19mm intermediate shelf (nominal size1200x2400mm).

.2 pre-manufactured chairs and table with manufacturer date no later than 2024.

.3 pre-manufactured office desk manufacturer date no later than 2024.

.4 Fifteen (15) standard office chairs.

.5 Fire extinguisher, first aid kit, and eye wash bottle station.

.6 One (1) 610mm x 1220mm whiteboard with two (2) sets of dry erase markers and erasers.

.7 One (1) 1400mm flat screen, smart tv with wall mounting bracket and equipped with conference call speaker, camera, and microphone to suit Microsoft Teams Conference Call Software. Contractor shall install at the location specified by the Contract Administrator.

.8 One (1) garbage bin.

.9 One (1) recycling bin.

.10 1220mm x 1220mm new cork billboard for Contract Administrator safety sheets.

.11 1220mm x 910mm new white board.

.11 The trailer to be insulated, electrically heated, air-conditioned and electrically lighted as follows:

.1 Wall-mounted electrical heaters sized to maintain an interior temperature of 21°C when the outside temperature is -30°C.

.2 Wall mounted air conditioning units.

.3 Temperature to be controlled at 21°C year-round.

.4 Adequate lighting with supplementary lighting in each area, including over the plan table and desks.

.5 Electrical outlets in office and meeting room (4 minimum) as required.

.12 Provide one (1) exterior door to the trailer meeting room and one (1) exterior door to the office with suitable exterior locks.

.1 Doors to be keyed alike with at least eight (8) sets of keys.

.13 Provide one (1) interior door from office to meeting room.

.1 Door to be keyed with at least eight (8) sets of keys.

.14 Provide one (1) interior door from washroom to meeting room.

.1 Door to with privacy lockset with outside emergency keyed and occupied indicator. Emergency key keyed alike to interior office door.

.15 Provide at least two windows within the meeting room and one window within office and, each window having a size of at least 2.0 m^2 on the opposite wall in which the exterior door is located. Provide window shades with screens.

.16 Provide exterior stair/landing in galvanized steel or aluminum serrated grating with galvanized steel or aluminum guardrail and handrail at each exterior door location.

.17 Provide washroom facility within the trailer with hot and cold sink, toilet, waste basket and mirror for the sole use of the Contract Administrator. Maintain a supply of paper towels, toilet paper, and soap throughout the duration of the project.

.18 Provide professional Contractor Third-Party janitorial services twice per week. Supply and install all washroom supplies at the same time.

.19 Provide heat tracing to prevent freezing of pipes when not in use.

.20 Provide one (1) printer/copier/scanner multi-function machine to meet the following specifications:

.1 Required functions - colour copying, printing, scanning, colour digital sending, with multi-tasking capability.

.2 Print speed - 40 pages per minute (colour or black and white).

.3 Monthly duty cycle 5000-20,000 pages.

.4 Processor speed 800 mHz.

.5 Memory 1 GB RAM

.6 Hard disk 320 GB.

.7 Print technology and quality -laser, up to 600 x 600 pdi.

.8 Number of cartridges - 4 (1 each high yield cyan, magenta, yellow).

.9 Number of paper trays - 4 (letter, legal, 11x17, with 1 multi- purpose adjustable tray).

.10 Duplex printing – automatic.

.11 Document finishing sheet fed, job separator, stacking, stapling.

.12 Scanner type – flattened.

.13 Scanner resolution - up to 600 dpi with scan resolution software.

.14 Task speed- 5.6 seconds, 600 x 600 dpi.

.15 Maximum scan size 11x17.

.16 Automatic document feeder capacity - 50 sheets.

.17 Copier- resolution of 600x600 dpi for colour, copy reduce/enlarge settings of 25 to 400%, with number of copies up to 999 copies maximum.

.18 Fax- resolution of 300 x 300 dpi for black, polling.

.19 Connectivity- internal and external print servers, plus wireless print servers.

.20 Software - print drivers and installation software.

.21 Pay the lease or purchase costs for printer/copier/scanner, and associated equipment, including maintenance, technical support, paper, cartridge and supply services.

.22 Provide Wi-Fi and high-speed mobile Internet (minimum internet speed of 5 Gbps download and 1 Gbps upload) access suitable for a unlimited monthly usage. Pay for the monthly charges by the Internet service provider. Internet access shall be designated for the Contract Administrator's trailer and shall not be shared with the Contractor's trailer.

.23 Provide connection services in each office and meeting room for the printer. Provide technical services to assist the Contract Administrator and its representatives to connect to the Wi-Fi and printing system.

.24 Maintain the field office and the performance of the office equipment as specified until at least three (3) months following Substantial Performance.

.25 Provide parking space with a satisfactory wearing surface to accommodate four (4) Contract Administrator vehicles minimum. Provide a walkway from the trailer exterior doors to the parking area and keep both free of water, mud, ice and snow.

.26 Provide two (2) dedicated 15-amp circuits for two exterior duplex receptacles on the exterior trailer surface adjacent to the parking spots.

.2 Contractor trailers for Contractor staff usage:

.1 Provide weather tight temporary trailers, meeting the Contractor's requirements in accordance with D12 Safe Work Plan.

.1 Provide anchorage of temporary trailers in accordance with this Section.

.3 Contractor Equipment, Tool and Materials Storage:

.1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

.1 Provide anchorage of temporary sheds in accordance with this Section.

2.2 CONSTRUCTION AIDS

.1 Construction Hoists and Cranes:

.1 Provide, operate and maintain hoists or cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.

.2 Provide, install, maintain, locate where directed and pay costs for hoisting equipment if required. Equipment shall be positioned so as not to interfere with Work.

.3 Operate equipment by qualified operator along with well-trained flag and signal persons.

.4 Be responsible for necessary permits and inspection fees.

.5 Trade Sections shall make their own financial and schedule arrangements with Contractor for use thereof. Provide concrete pads for hoisting equipment.

.2 Scaffolding:

.1 Scaffolding in accordance with CAN/CSA-S269.2.

.2 Erect fixed or mobile scaffolding as applicable independent of walls. Use it in manner as to interfere as little as possible with other Sections. When not in use, move it as necessary to permit installation of other work. Construct and maintain scaffolding in rigid, secure and safe manner. Remove it promptly when no longer required.

.3 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms, temporary stairs and all other construction items necessary to complete the Work.

2.3 CONSTRUCTION SIGNAGE

.1 Provide and erect, within four weeks of signing Contract, a project sign in a location designated by Contract Administrator.

.2 Construct project identification site sign comprising foundation, framing, and one 1200 mm x 2400 mm signboard painted with exhibit lettering produced by a professional signage supplier.

.1 Foundations: Minimum 20 MPa concrete to CAN/CSA-A23.1.

.2 Framework and battens: by Contractor's Engineer.

.3 Signboard: 19 mm Medium Density Overlaid Douglas Fir Plywood to CSA O121.

.4 Paint: minimum two coats of latex exterior primer to MPI standard, complete with minimum of two topcoats utilizing exterior topcoat in accordance with MPI standards. Paint to be compatible with vinyl lettering and logo materials.

.5 Fasteners: hot-dip galvanized steel nails and carriage bolts.

.6 Provide exterior grade, UV resistant vinyl lettering, logos and rendering.

.1 City and Contract Administrator will provide their logo images to the Contractor in digit format through the Contract Administrator.

.2 Contract Administrator will provide architectural rendering image in digit format.

.7 Indicate on sign, name of Owner, Contract Administrator and Contractor, of a design style established by Contract Administrator.

.8 Paint all surfaces of signboard and framing as noted above.

.3 Maintain signs and notices in good condition for duration of project and dispose of off site on completion of project or earlier if directed by Contract Administrator.

.4 Signs and notices for safety and instruction to CAN/CSA-Z321.

.5 No other signs or advertisements, other than warning and traffic signs, or required by funding parties, are permitted on site.

3 Execution

3.1 TEMPORARY LIGHT, POWER AND WATER

.1 Provide and maintain adequate temporary light, power and water as required by all trades for work to proceed without delay at all times of year.

.2 Provide continuous temporary electric power required during execution of Work for temporary lighting, operating of electric pumps, motors, vibrators, power tools, electric cranes, hoists, other equipment and as required.

.3 Maintain illumination on all floors and stairs of minimum 161 lux (15 foot-candles). When finishing trades are performing work, provide illumination comparable to final illumination.

Extension cords, lamps and hoses shall be provided by those using them in accordance with governing regulations and ordinances.

.4 Provide a continuous supply of potable water for execution of Work. Ensure adequate pressure at each floor. Provide and maintain temporary water lines, extensions, hoses, and pumps as required.

.5 Be responsible for materials, plant, tools or equipment on Site.

.6 Do not use any of permanent facilities and controls without obtaining written permission from Contract Administrator.

3.2 TEMPORARY HEATING AND VENTILATION

.1 Provide temporary heating required during execution of Work, including attendance, maintenance and fuel.

.2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.

.3 Provide temporary heat and ventilation in enclosed areas as required to:

.1 Facilitate progress of Work.

.2 Protect Work and products against dampness and cold.

.3 Prevent moisture condensation on surfaces.

.4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.

.5 Provide adequate ventilation to meet health regulations for safe working environment.

.6 Maintain temperatures of minimum 10 degrees C in areas where Work is in progress.

.7 Ventilating:

.1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during execution of Work.

.2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.

.3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.

.4 Ventilate storage spaces containing hazardous or volatile materials.

.5 Ventilate temporary sanitary facilities.

.6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

.8 Permanent heating system of building, may not be used when available. Be responsible for damage to heating system if use is permitted.

.9 On completion of Work for which permanent heating system is used, replace filters and bearings.

.10 Ensure Date of Substantial Performance and Warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Contract Administrator.

.11 Maintain strict supervision of operation of temporary heating and ventilating equipment to:

.1 Conform with applicable codes and standards.

.2 Enforce safe practices.

.3 Prevent abuse of services.

.4 Prevent damage to finishes.

.5 Vent direct-fired combustion units to outside.

.12 Be responsible for damage to Work due to failure in providing adequate heat and protection during execution of Work.

3.3 TEMPORARY DRAINAGE

.1 Excavation and preparation of temporary drainage and drainage preparations are incidental to the Contract Price and are not unit price payable items.

.2 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

.3 Keep site properly and efficiently drained during execution of Work and until completion of Work. Be responsible for disturbances, dirt and damage which may be caused by or result from water backing up or flowing over, through, from or along any part of Work or due to operations, which may cause water to flow elsewhere. Drain water away from Site without causing any danger to public health.

3.4 SANITARY FACILITIES

.1 Provide and maintain temporary facilities in compliance with The Occupational Health and Safety Act, applicable codes and by-laws, sanitary facilities for use of workers.

.2 Provide sufficient sanitary facilities for all persons employed on the Contract subject to approval of type, size and location by the local health authorities and the Contract Administrator.

.3 Maintain facilities with all required toilet room supplies in a clean and sanitary condition and disinfect frequently.

.4 Prohibit the committing of nuisance on the site and any employee found violating such a provision shall be promptly discharged.

.5 Remove any contaminated soil and replace with fresh clean material. Leave site in a clean sanitary condition.

.6 Contractor staff are not to use Contract Administrator's or City's facilities.

.7 The Contractor is to secure premises to prevent use by external parties. Provide signage as necessary.

3.5 SITE STORAGE AND LOADING

.1 Confine work and operations of employees by Construction Contract Documents. Do not unreasonably encumber premises with products.

.2 Do not load or permit to load any part of Work with weight or force that will endanger the Work.

3.6 VEHICULAR ACCESS, CRANE SUPPORTS AND PARKING

.1 Access Road, Parking, and Traffic Control

.1 Provide access roads as may be necessary to provide safe and adequate access for materials, products and other supplies. Provide and maintain access sidewalks, roadways, and similar facilities as may be required for access to the Work.

.2 Temporary access road(s), temporary parking pads, related preparations and appurtenances are incidental to the Contract Price and are not unit price payable items.

.1 Clay, granular and concrete for temporary crane bases and support substrates, preparations and appurtenances are incidental to the Contract Price and are not unit price payable items.

.3 Do not block public roads or impede traffic during work of this Project and if required to temporary block traffic then provide flag person to direct traffic acceptable to Municipal authorities. Remove accumulations of ice and snow from areas providing access to Site. Ensure that access is available for emergency vehicles. Comply with fire plan for vehicular traffic.

.4 Provide roads, walks, ramps, stairs and other such means of access as necessary. Maintain temporary entrances to building(s) including enclosed hoarding as required. Maintain access to existing service entrance(s) at all times, including ready access for fuel oil trucks and delivery vehicles. Bridge excavations with construction to safely support any load that could be imposed or provide personnel to assist in deliveries to building(s) as required.

.1 Do not be nuisance to public traffic any time. Manage construction traffic by using designated roads and by providing trained flag persons to direct public traffic as appropriate.

.2 Protect travelling public from damage to person and property.

.3 Construction Contractor's traffic on roads selected for hauling material to and from Site to interfere as little as possible with public traffic.

.4 Verify adequacy of existing roads and allowable load limit on these roads. Construction Contractor: responsible for repair of damage to roads caused by construction operations.

.5 Construct access and haul roads necessary.

.6 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.

.7 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.

.8 Dust control: adequate to ensure safe operation at all times.

.9 Location, grade, width, and alignment of construction and hauling roads: subject to approval by the Contract Administrator.

.10 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.

.11 Provide snow removal during period of Work.

.12 Remove, upon completion of work, haul roads designated by the Contract Administrator.

.5 Construction Parking:

1. Parking on site is limited to the space available. The City will not be responsible for parking fines incurred by Contractor, Subcontractors or their employees.
2. Parking will be permitted On Site.
3. Provide and maintain adequate access to Project Site.

3.7 TREE AND SHRUB PROTECTION

.1 Protect trees and shrubs existing on Site and on adjacent properties, which are to be retained, except where otherwise required by Contract Documents. Do not remove interfering branches adjacent to excavation without obtaining prior approval from Contract Administrator. Do not injure tree trunks.

.2 Protect roots against damage due to compaction of soil, excavating, backfilling and rough grading, and against oil, gasoline and other chemicals due to spillage and for seepage.

.1 Keep disturbance of root system to absolute minimum and promptly protect and cover exposed roots. Replace damaged trees as directed without any expense to the City.

.2 Fence off existing trees at drip line to protect root system.

.3 Carefully wrap trees adjacent to the Work in accordance with the City of Winnipeg Standard Construction Specifications.

3.8 POLLUTION CONTROL

.1 Take appropriate dust control measures to avoid contamination of adjacent areas near Site from dust. Respond immediately to complaints of dust received from public, authorities, or Contract Administrator. Obtain approval from authorities having jurisdiction before employing chemicals for dust control measures. Haul dusty materials by covered vehicles. Transport wet materials in watertight vehicles. Keep public and private roads free of dust, mud and construction debris resulting from trucks employed on this Project.

3.9 NOISE AND VIBRATION CONTROL

.1 Control noise and vibration generated by Work. Respond immediately to complaints of noise and vibration received from public, authorities, or Contract Administrator.

3.10 SNOW REMOVAL

.1 Remove ice and snow from site and from roof deck when roofing operations are in session.

.2 Be responsible to keep access road and circulation paths accessible during snowfall. Remove snow as necessary to prevent interruption to work in progress.

3.11 CLEAN-UP

.1 Provide cleaning of the trailer by Contractor third-party cleaning service with minimum cleaning, but not limited to the following:

.1 Clean and vacuum floor once per week.

.2 Clean kitchenette and workspace once per week.

.3 Clean windows monthly.

.4 Remove garbage daily.

.2 Remove construction debris, waste materials, packaging material from Work Site daily.

.3 Clean dirt or mud tracked onto paved or surfaced roadways.

.4 Store materials resulting from demolition activities that are salvageable.

.5 Stack stored new or salvaged material in construction facilities.

END OF SECTION

1 General

1.1 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.2 ACCESS TO SITE

.1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.3 PUBLIC TRAFFIC FLOW

.1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect the public.

1.4 FIRE ROUTES

.1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.5 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

1.6 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with Contract Administrator locations and installation schedule five days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

2 Products

2.1 NOT USED.

3 Execution

3.1 COVERED WALKWAY

.1 Erect structurally adequate, protective, covered walkway for passage of individuals along adjacent public streets. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.

.2 Construct covered walkways using scaffold or shoring framing.

.3 Provide wood-plank overhead decking, protective plywood enclosure walls, handrails, barricades, warning signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.

.4 Provide lockable truck entrance gates and at least one pedestrian door and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys.

.5 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by authority having jurisdiction.

.6 Paint and maintain in a manner approved by the City and Contract Administrator.

3.2 TEMPORARY FENCED ENCLOSURES

.1 Erect temporary site enclosure using new 1200 mm (48”) high snow fence wired to rolled steel "T" bar fence posts spaced at 2400 mm (96”) oc. Provide 1 (one) lockable truck gate. Maintain fence in good repair.

.2 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

3.3 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.

.2 Provide as required by governing authorities having jurisdiction.

3.4 WEATHER ENCLOSURES

.1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

.2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.

.3 Design enclosures to withstand wind pressure and snow loading.

3.5 DUST TIGHT SCREENS

.1 Provide dust tight screens to localize dust generating activities, and for protection of workers, finished areas of Work and public. Maintain and relocate protection until such work is complete.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Section includes, but is not limited to:

.1 Preparation of an Erosion and Sedimentation Control (ESC) Plan as per Civil drawings and Local Authority Having Jurisdiction (AHJ) Approval, in compliance with all municipal, provincial or federal acts and regulations.

.2 Implementing and monitoring the ESC Plan and other administrative procedures applicable to the ESC scope of Work.

1.2 RELATED SECTIONS

.1 01 35 40 LEED Sustainable Design Requirements

.2 Part E – Specification

1.3 REFERENCES

.1 2003 US EPA Construction General Permit.

.2 LEEDv4 BD+C Reference Guide.

.3 LEEDv4.1 BD+C Reference Guide.

1.4 PROCEDURES

.1 Implement and monitor the ESC Plan in compliance with all applicable municipal, provincial, or federal acts, regulations and compliance protocols.

.2 Create and implement a Stormwater Pollution and Prevention Plan for all construction activities associated with the Project as per the Leadership in Energy and Environmental Design (LEED) Reference Guide for Building Design and Construction Version 4 (LEED BD+C).

1.5 REQUIREMENTS

.1 Minimize the disturbance of existing vegetation and soil on the construction site.

.2 Prevent the loss of soil from the site (including topsoil stockpiled for reuse) resulting from storm water runoff, wind erosion, construction activities and site use including egress/access.

.3 Prevent sedimentation of storm water or receiving streams.

.4 Prevent pollution of the air with dust and particulate matter.

.5 Meet or exceed 2012 US EPA Construction General Permit or equivalent local standard and codes, whichever is more stringent.

.6 Meet or exceed the reference standards and requirements of the LEEDv4 Prerequisite Construction Activity Pollution Prevention

1.6 DESCRIPTION OF WORK

.1 The Contractor site representative (or other person designated by the Contractor) shall be responsible for erosion and sedimentation control requirements as per ESC Plan and LEED requirements for the overall site including erosion and sedimentation control monitoring and maintenance.

.2 The Contractor site representative or designate shall manage and control the overall project erosion and sedimentation control system for the duration of the entire project.

.3 Assess the construction site to determine conditions (including local topography, soil types, water flows, etc.) that may affect implementation of the ESC Plan and ES Controls.

.4 Implement and document measures to achieve the erosion and sedimentation control as per the ESC Plan.

.5 Follow strategy based on the best management practices for stabilization and structural measures outlined in 2012 US EPA Construction General Permit or local authority requirements, whichever is more stringent.

.6 The City Guidelines for Erosion & Sedimentation Control may be used in place of local authority guidelines if the construction pollution prevention provisions of local jurisdiction are less stringent than those of the 2012 US EPA Construction General Permit.

.7 Minimize the amount of disturbed soil and preserve existing vegetation by establishing construction boundaries. Clearly indicate the limits of construction, grading and disturbance. Clearly mark any trees to be preserved and protect them from disturbances.

.8 Show the stabilization and structural measures selected for the site on the drawings.

1.7 REGULATORY REQUIREMENTS

.1 Comply with all requirements and regulations of Government of Canada Department of Fisheries and Oceans Canada and of Alberta Ministry of Environment and Sustainable Resource Development, and all other applicable regulations, codes and standards, with regards to sedimentation and erosion control measures.

.2 Be aware of all relevant Bylaws and Codes affecting activities on site; comply with all Bylaw requirements.

.3 Obtain approval for any changes or revisions to the ESC Plan from the Authority Having Jurisdiction and the Civil Contract Administrator as required.

.4 Assume all responsibilities and obligations described by the approved ESC Plan. Be fully responsible for all stoppages of work as a result of noncompliance with this Plan.

.5 Implement measures of the erosion and sedimentation control plan for the entire duration of the Construction Contract. During cessation of construction activity due to winter shutdown (if any), continue to provide erosion and sedimentation control including monitoring and maintenance measures in accordance with the ESC Plan.

.6 Submit any revisions to the ESC Plan to the Authority having Jurisdiction for approval prior to commencement of the Work. Notify the Authority Having Jurisdiction of any changes to the ESC Plan during construction.

.7 Maintain and operate in a manner acceptable to the authorities having jurisdiction, who will conduct site visits. Arrange all such site visits with the appropriate Authority having jurisdiction.

.8 Construction work will be suspended if regulatory requirements are not complied with. No extra compensation or extension of time for the Contract will be allowed.

.9 There is a zero discharge policy regarding saw cutting slurry entering the storm sewer system. All saw cutting slurry must be contained in a manner that will ensure that none of the materials enter the stormwater system, in accordance with the Authority having Jurisdiction requirements.

1.8 INSPECTIONS AND MAINTENANCE

.1 Construct, regularly inspect, maintain and repair/replace as necessary, ESC measures until such time that risk of silt, sediment and/or deleterious materials entering the storm drainage system or surrounding environment for the construction phase has passed.

.2 Implement measures of the erosion and sedimentation control plan for the entire duration of the Construction Contract. During cessation of construction activity due to winter shutdown (if any), continue to provide erosion and sedimentation control including monitoring and maintenance measures in accordance with the ESC Plan.

1.9 SUBMITTALS AND DOCUMENTATION

.1 Submit in accordance with Section 01 33 00 – Submittal Procedure.

.2 Maintain one complete, up-to-date hard copy of the ESC Plan at the job site in a location easily accessible for review by all workers and visitors.

.3 Post updates and changes to the hard copy ESC Plan manually; include a description of the revision or addition. Sign and date any revisions or changes to the ESC Plan.

.4 Report on Erosion & Sediment control at weekly intervals. Ensure that the reporting summary details the regular monitoring of Erosion and Sediment Control including control measures utilized, modifications required, and their location.

.5 In the event of winter shutdown periods or cessation of construction activity continue to provide monitoring and maintenance of ESC Measures on a bi-monthly basis and provide ESC Reports with photos, to the LEED Consultant.

.6 Conduct weekly ESC inspections and document compliance with the ESC Plan, including photographs of all ES controls. Provide each ESC inspection report to the LEED Consultant.

.7 Provide an additional report, confirming inspection of ESC Measures and Maintenance within 24 hours after each rain or snowmelt event to the LEED Consultant.

.8 Take photos of all ESC controls as approved by the Contract Administrator (e.g., construction entrance, silt fencing, catch basins, trap lows, stabilized soil stockpiles) to provide a visual record demonstrating compliance and cross reference them to the ESC plan.

.9 Update the ESC Plan as required to reflect any change, addition, removal or modification of ES controls, structures or other measures, in response to changing site conditions or construction progress. Retain all versions of the ESC Plan and provide all versions to the Contract Administrator. Post the most recent version of the ESC Plan on site upon approval.

.10 If using local standards, provide documentation comparing local standards to EPA CGP.

1.10 ESC ORIENTATION AND WORKER TRAINING

.1 Prior to commencement of Construction, conduct a pre-construction meeting to present the ESC Plan to all Contractors and Subtrades. Ensure all Subcontractors receive training on ESC Plan requirements.

.2 Describe and promote the ESC Plan requirements and responsibilities.

.3 Communicate the requirements of this Section to all Subcontractors.

.4 Train Subcontractors about proper erosion and sedimentation control protocol.

1.11 SCHEDULING

.1 Coordinate work with other activities at site to ensure timely and orderly progress of the Work.

.2 Refer to ESC Inspection Form

2 Products

2.1 MATERIALS

.1 Retain on site in an accessible location sufficient number and quality of ES control equipment and devices to effectively comply with and maintain the ESC measures stated in the ESC Plan.

3 Execution

NOT USED

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Product requirements and documentation for compliance to the Leadership in Energy and Environmental Design (LEED) Green Building Rating System for Building Design and Construction version 4 (LEED v4 BD+C) and version 4.1 (LEED v4.1 BD+C) including all Addenda, Clarifications, Credit Interpretation Rulings (CIR), and LEED Interpretations (LI).

1.2 RELATED REQUIREMENTS

.1 Section 01 35 40 LEED Sustainable Design Requirements

2 Products

2.1 EXTERIOR HARD SURFACE LANDSCAPE, PAVING MATERIAL, AND ARCHITECTURAL SHADING DEVICES

.1 Solar Reflectance (SR) of at least 0.33 at installation or three-year aged SR of at least 0.28.

.2 Any open-grid pavement system must be at least 50% pervious.

2.2 EXTERIOR LIGHTING FIXTURES

.1 All exterior luminaires to meet Full Cutoff IESNA Classification.

.2 Exterior lighting backlight and glare ratings to comply with IES-TM-15-11 Addendum A.

.3 Exterior illuminated signage not to exceed 200cd/m^2 during nighttime hours and 2000cd/m^2 during daytime hours.

2.3 ELECTRIC VEHICLE SUPPLY EQUIPMENT (ESVE)

.1 EVSE must provide a minimum of Level 2 (208-240 Volt) charging capacity.

.2 Plug standard shall be J1772 or IEC 62196.

.3 EVSE to meet connected functionality criteria for ENERGY STAR certified Electric Vehicle Supply Equipment.

.4 EVSE shall be network accessible or internet addressable.

.5 EVSE shall be capable of participating in time-of-use market signals.

2.4 PLUMBING FIXTURES, FITTINGS AND PIPING

.1 All installed toilets, urinals, private lavatory faucets, showerheads and aerators eligible for labeling must be labeled WaterSense compliant for the model selected.

.2 All installed toilets and urinals eligible for labeling must be WaterSense labeled for the flush valve selected.

.3 Flow and flush rates shall not exceed the following:

.1 Toilets: 4.2 litres per flush

.2 Urinals: 0.125 litres per flush

.3 Lavatory Faucets, Aerators: 1.32 litres per minute

.4 Private Lavatory Faucets and Aerators: 1.9 litres per minute

.5 Kitchen Sink Faucets: 5.7 litres per minute

.6 Other Sink Faucets: 1.9 litres per minute

.7 Showerheads: 5.7 litres per minute

2.5 PROCESS WATER FIXTURES, EQUIPMENT, AND APPLIANCES

.1 Installed water-use fixtures, equipment and appliances to meet minimum performance standards:

.1 Pre-Rinse Spray Valves flow rate must not exceed 4.9 litres per minute.

.2 Residential model dishwashers to be ENERGY STAR.

.3 Residential Clothes Washers to be ENERGY STAR.

.4 Commercial dishwashers not to exceed the rate prescribed in LEED Reference Guide Table 4 Standard for Appliances.

.5 Ice Machines to be ENERGY STAR and air-cooled or closed-loop.

2.6 REFRIGERANTS

.1 HVAC systems must not use chlorofluorocarbon (CFC) or hydrochlorofluorocarbon (HCFC) based refrigerants

.2 Base building HVACR equipment refrigerants to have zero (0) Ozone Depleting Potential and Low Global Warming Potential.

2.7 FIRE SUPPRESSION SYSTEMS

.1 Fire suppression systems must not contain ozone-depleting substances.

2.8 PRODUCTS

.1 A minimum twenty (20) different permanently installed products from at least five (5) manufacturers must have Environmental Product Declarations (EPD) which conform to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930 and have at least Cradle to Gate scope:

.2 Install materials with recycled content:

.3 A minimum of twenty (20) different products from at least five (5) manufacturers to have a Material Ingredient Report demonstrating the chemical inventory of the product to at least 1000ppm:

2.9 WOOD AND WOOD PRODUCTS

.1 All composite wood products to comply with California Air Resources Board ATCM or Environmental Protection Agency (EPA) Toxic Substance Control Act (TSCA) Title VI for ultra-low emitting formaldehyde (ULEF) or no added formaldehyde (NAF) resins.

.2 Structural wood panel products to comply with PS1 or PS2 and be labeled Bond Classification Exposure 1 or Exterior.

.3 Structural engineered wood products to comply with the requirements of LEED Interpretation 10466 for the respective category of composite wood:

.1 ANSI A190.1 Glue Laminated Timber

.2 ASTM D5456 Structural Composite Lumber

.3 ASTM D5055 I-Joist

.4 ANSI PRG 320 Cross Laminated Timber

.5 PS 20-15 Finger Jointed Lumber

2.10 CEILINGS, FLOORING, INSULATION

.1 Comply with VOC emissions evaluation California Department of Public Health (CDPH) Standard Method v1.2-2017 using the applicable exposure scenario.

2.11 SITE-APPLIED PAINTS AND COATINGS

.1 Comply with California Department of Public Health (CDPH) Standard Method v1.2-2017 using the applicable exposure scenario.

.2 Must not contain lead or added cadmium.

.3 Comply with VOC limits of California Air Resources Board (CARB) 2007 Suggested Control Measure for Architectural Coatings or South Coast Air Quality Management District (SCAQMD) Rule 1113 effective February 5, 2016.

2.12 ADHESIVES AND SEALANTS

.1 Comply with VOC limits of California Air Resources Board (CARB) 2007 Suggested Control Measure for Architectural Coatings or South Coast Air Quality Management District (SCAQMD) Rule 1168 effective October 6, 2017.

2.13 ENTRYWAY SYSTEMS

.1 Entryway systems must be at least 3 meters (10 feet) long in primary direction of travel. Acceptable entryway systems:

.1 Permanently installed grate, grille, or slotted system allowing for cleaning beneath.

.2 Permanently installed walk-off mats.

.3 Roll-out mats if permanently maintained weekly by a contracted service.

2.14 AIR FILTRATION

.1 Install air filtration media with Minimum Efficiency Reporting Value (MERV) 13 in all air handling units for return and outside air delivered to the air handling system.

2.15 LIGHTING

.1 All lighting to be high-efficiency Light Emitting Diode (LED) type with rated life of at least 24,000 hours.

.2 Light fixture luminance to be less than 7000 cd/m^2 between 45 and 90 degrees from nadir.

.3 Light sources to have a colour rendering index (CRI) of 90 or higher and colour fidelity index (CFI) at least 78 and gamut index of 97-110.

2.16 LIGHTING CONTROLS

.1 Lighting control must be dimmable or multi-level.

2.17 SUBMETERING

.1 Energy submeters must:

.1 Record at intervals of one (1) hour or less.

.2 Transmit data to a remote location.

.3 Record consumption and demand.

.4 Store data for minimum 36 months.

.2 Energy monitoring system must be capably of reporting hourly, daily, monthly and annual energy use.

2.18 LANDSCAPING

.1 Vegetation to be of drought-tolerant, hardy, native, adapted varieties.

2.19 NO SMOKING SIGNAGE

.1 Provide permanent signage indicating:

.1 No Smoking Allowed On-Site or

.2 No Smoking within 7.5m

3 Execution

NOT USED

END OF SECTION

1 General

1.1 GENERAL

.1 Products refer to materials, manufactured components and assemblies, fixtures and equipment incorporated in the work.

.2 As far as practical, favour use of products of Canadian manufacture unless such products are not manufactured in Canada, are specified otherwise, or are not competitive.

.3 Products to be used in the performance of the Work and on which the Bid was based shall be in production at time of tender date, with a precise model and shop drawings available for viewing.

.4 Where alternative products are specified, or where alternatives are proposed, these products shall be comparable in construction, type, function, quality, performance, and, where applicable, in appearance. Where specified alternatives are used in the Stipulated Price for the work, they shall be subject to final approval.

.5 Incorporate products in the work in strict accordance with Manufacturers' directions, instructions and specifications, where reference is made to them, shall include full information on storing, handling, preparing, mixing, installing, erecting, applying, and other matters concerning the materials that are pertinent to their use and their relationship to materials with which they are incorporated.

.6 Products delivered to the Project site for incorporation in the work shall be considered the property of the City. Maintain protection and security of products stored on the site after payment has been made for them.

.7 Do not install permanently incorporated labels, trademarks and nameplates, in visible locations unless required for operating instructions or by authorities having jurisdiction.

1.2 PRODUCT HANDLING

.1 Manufacture, pack, ship, deliver and store products so that no damage occurs to structural qualities and finish appearance, nor in any other way detrimental to their function or appearance, or both.

.2 Ensure that products, while transported, stored or installed, are not exposed to an environment which would increase their moisture content beyond the maximum specified.

.3 Schedule early delivery of products to enable work to be executed without delay. Before delivery, arrange for receiving at site.

.4 Deliver and store products at site where directed by the City or Contract Administrator.

.5 Brace work such as door frames, large window units and similar products to prevent distortion or breakage in handling.

.6 Deliver packaged products, and store until use, in original unopened wrapping or containers, with manufacturer's seals and labels intact.

.7 Label packaged products to describe contents, quantity and other information as specified.

.8 Label fire-rated products to indicate approval of Underwriters' Laboratories.

.9 Product handling requirements may be repeated, and additional requirements specified, in other Sections.

1.3 STORAGE AND PROTECTION

.1 Store products on site with secure protection against all harmful environmental conditions. Prevent damage, adulteration, staining and soiling of materials while stored.

.2 Protect prefinished metal surfaces by protective coatings or wrappings until time of final cleanup specified in Section 01 77 19 – Closeout Requirements. Protection shall be easily removable under work of Section 01 77 19 – Closeout Requirements without damage to finishes.

.3 Store manufactured products in accordance with manufacturers' instructions.

.4 Store steel, lumber, masonry units, and similar products on platforms raised clear of ground.

.5 Store finished products and woodwork under cover at all times.

.6 Do not store products at locations or in such a manner that they damage previously completed work.

.7 Storage and special protection requirements may be repeated and additional requirements specified, in other Sections.

1.4 SCHEDULING OF PRODUCT DELIVERY

.1 Verify that products supplied by all Sections are ordered from suppliers in sufficient time to ensure delivery for incorporation in the work within the time limits established by approved construction schedule.

.2 Obtain confirmed delivery dates from product suppliers.

.3 Immediately inform the Contract Administrator should supplier's confirmation of delivery dates indicate that Project completion may be delayed.

.4 Submit copies of purchase orders and confirmations of delivery dates for products as may be requested.

.5 A schedule of product delivery shall be established and reviewed at each job site meeting.

1.5 DEFECTIVE PRODUCTS AND WORK

.1 Products and work that are defective, not in accordance with the Specifications, or defaced or damaged through negligence of the Contractor, his employees or Subcontractors, or by fire, weather or any other cause will be rejected for incorporation in the work whether or not incorporated in the work.

.2 Remove rejected products and work from the premises immediately.

.3 Replace rejected products and work with no delay after rejection. Provide replacement products and execute replacement work precisely as required by the Specifications for the defective work replaced. Previous inspection and payment shall not relieve the Contractor from the obligation of providing sound and satisfactory work in compliance with the Specifications.

.4 Testing and retesting of any part of the work as directed by the City, Contract Administrator or Contractor to establish its conformance to the Contract Documents shall be performed at no addition to the Contract Price.

1.6 WORKERS, SUPPLIERS AND SUBCONTRACTORS

.1 Assign work only to workers, suppliers, and Subcontractors who have complete knowledge, not only of the conditions of the Specifications, but of jurisdictional requirements, and reference standards and specifications.

.2 Certified and qualified installers of a specific product line shall be used when called for in these Specifications.

2 Products

2.1 SPECIFIED PRODUCTS

.1 Products used for temporary facilities may have been previously used, providing they are sound in structural qualities.

.2 Specified Options: The Work is based on materials, Products and systems specified by manufacturer's catalogued trade names, references to standards, by prescriptive specifications and by performance specifications.

.1 Where only one manufacturer's catalogued trade name is specified for a Product, the Product is single sourced and shall be supplied by the specified manufacturer, or an acceptable alternative in accordance with B7-Substitutes.

.2 Where more than one manufacturer's catalogue trade name is specified for a Product, supply the Product from any one of those manufacturers specified, or an acceptable alternative in accordance with B7-Substitutes.

.3 When a Product is specified by reference to a standard, select any Product from any manufacturer that meets or exceeds the requirements of the standard.

.4 When a Product or system is specified by prescriptive or performance specifications, provide any Product or system which meets or exceeds the requirements of the prescriptive or performance specifications.

.5 The onus is on the Contractor to prove compliance with governing published standards, prescriptive specifications and with performance specifications.

.3 Products, materials, equipment and articles (referred to as Products throughout the Contract Documents) incorporated in the Work shall be new, not damaged or defective, and of the quality standards specified, for the purpose intended. If requested, furnish evidence as to type, source and quality of Products Provided.

.4 Where Contract Documents list alternative Products or alternative manufacturers, select as applicable, any one Product from any one manufacturer meeting performance of specifications.

.5 Where Contract Documents require design of a Product or system, and minimum material requirements are specified, the design of such Product or system shall employ materials specified within applicable section. Where secondary materials or components are not specified, augment with materials meeting applicable code limitations, and incorporating compatibility criteria with adjacent work.

.6 Defective Products, whenever identified prior to completion of the Work, will be rejected, regardless of previous reviews. Review of the Work by the Contract Administrator or inspection and testing companies does not relieve the Contractor of the responsibility for executing the Work in accordance with the requirements of the Contract Documents but is a precaution against oversight or error. Remove and replace defective Products and be responsible for delays and expenses caused by rejection at no additional cost to the City.

.7 Should any dispute arise as to quality or fitness of Products, the decision rests strictly with Contract Administrator based upon the requirements of the Contract Documents.

.8 Unless otherwise indicated in the Contract Documents, maintain uniformity of manufacturer for any like item, material, equipment or assembly for the duration of the Work.

.9 Products exposed in the finished work shall be uniform in colour, texture, range, and quality, and be from one production run or batch, unless otherwise indicated.

.10 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical, electrical, machinery or like rooms.

.11 The City retains right to select from choices available within specified Products for colours, patterns, finishes or other options normally made available. Submit full range of Product options in accordance with 01 33 00 for such selection.

.12 Quality Control:

.1 Implement a system of quality control to ensure compliance with Contract Documents.

.2 Notify Contract Administrator of defects in the Work or departures from intent of Contract Documents that may occur during construction. Contract Administrator will recommend appropriate corrective action in accordance with requirements of the Contract.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in the Contract Documents, install or erect Products in accordance with manufacturer's printed instructions. Do not rely on labels or enclosures supplied with Products. Obtain printed instructions directly from manufacturers.

.2 Notify Contract Administrator in writing, of conflicts between the Contract Documents and manufacturer's instructions.

.3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Contract Administrator to require removal and re-installation at no additional cost to the City.

.4 Manufacturers' representatives shall have access to the Work at all times. Contractor shall render assistance and facilities for such access in order that the manufacturers' representatives may properly perform their function.

3.2 GALVANIC/DISSIMILAR METAL CORROSION

.1 Insulate dissimilar metals from each other by suitable plastic strips, washers or sleeves to prevent galvanic corrosion where conductive liquid or electrolyte exists.

3.3 WORKMANSHIP

.1 General:

.1 Execute the Work using workers experienced and skilled in the respective duties for which they are employed.

.2 Do not employ an unfit person or anyone unskilled in their required duties.

.3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with Contract Administrator, whose decision is final.

.4 Upon request by the Contract Administrator, submit proof of qualifications of Subcontractors to verify Subcontractor's qualifications and experience meet or exceed the requirements of the Contract Documents.

.1 If, upon review of the Contractor's Qualification Statement, that the Subcontractor does not meet the qualification requirements specified in the Contract Documents pertaining to the parts of the Work for which the Subcontractor has been retained, the Contractor shall replace the unqualified Subcontractor with a qualified Subcontractor, satisfactory to the City, at no additional cost to the City and at no increase in the Contract Time.

.2 Coordination:

.1 Ensure cooperation of workers in layout of the Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

.3 Cutting and Remedial Work:

.1 Perform cutting and remedial work required to make parts of the Work come together. Coordinate the Work to ensure this requirement is maintained. Obtain permission from Contract Administrator before commencing any cutting.

.4 Fastenings:

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action and corrosion between dissimilar metals and materials.

.5 Protection of work in progress:

.1 Take reasonable and necessary measures, including those required by authorities having jurisdiction, to Provide protection.

.2 Adequately protect parts of the Work completed or in progress. Parts of the Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Contract Administrator, at no additional cost to the City.

.3 Do not cut, drill or sleeve any load bearing structural member without written permission of Contract Administrator, unless specifically indicated.

.4 Keep floors free of oils, grease or other materials likely to discolour them or affect bond of applied surfaces.

.5 Protect work of other Subcontractors from damage while doing subsequent work. Damaged work shall be made good by appropriate Subcontractors but at expense of those causing damage.

.6 Protect existing buildings, curbs, roads and lanes. If, during the Work, any buildings, curbs, roads or lanes are damaged, bear costs for repairs.

.6 Existing Utilities:

.1 When breaking into or connecting to existing services or utilities, execute the Work at times approved by City, with a minimum of disturbance to City's ongoing operations, the Work, and traffic.

.2 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in a manner approved by authority having jurisdiction and stake or otherwise record location of capped service.

.7 Operational requirements: Operable Products shall be Provided fully operational and ready for intended use.

END OF SECTION

1 General

1.1 GENERAL – CLEANING AND WASTE MANAGEMENT

.1 Conduct work of this section in accordance with general requirements of the Contract documents.

.2 Conduct cleaning and disposal operations to comply with local ordinances and environmental protection legislation.

.3 Store volatile wastes in covered metal containers, and remove from premises at end of each working day.

.4 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

1.2 CLEANING DURING CONSTRUCTION

.1 Maintain the Work in tidy condition, free from accumulation of waste products and debris, other than that caused by the City or other Contractors.

.2 Remove waste material and debris from the work areas and deposit in waste container at the end of each working day.

.3 Vacuum clean interior areas prior to start of finishing work. Maintain areas free of dust and other contaminants during finishing operations.

.4 The overall responsibility for project cleanliness rests with the Contractor irrespective of whether the clean-up and removal of debris are related to work performed by Subcontractors.

1.3 WASTE MANAGEMENT

.1 Audit, separate and dispose of construction waste generated by new construction or by demolition of existing structures in whole or in part, in accordance with local laws and ordinances in place of Work.

.2 Fires, and burning of rubbish or waste on site is prohibited.

.3 Burying of rubbish or waste materials, except as specified herein, is prohibited.

.4 Disposal of waste or volatile materials such as mineral spirits, oil, gasoline or paint thinner into ground, waterways, or sewer systems is prohibited.

.5 Empty waste containers on a regular basis to prevent contamination of site and adjacent properties by wind-blown dust or debris.

1.4 FINAL CLEANING OPERATIONS

.1 Immediately following Date of Substantial Performance, and prior to the City occupancy of the building or portion of the building affected by the Work, conduct full and complete final cleaning operations.

.2 Final cleaning operations shall be performed by an experienced professional cleaning company, possessing equipment and personnel sufficient to perform full building cleaning operations.

.3 Remove all surplus products, tools, construction machinery and equipment not required for the performance of remaining work, and thereafter remove any remaining materials, equipment, waste and debris.

.4 Make arrangements with and obtain permits from the Authorities Having Jurisdiction for disposal of waste and debris.

.5 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.6 Cleaning operations shall include the removal of all stains, spots, scuff marks, dirt, dust, remaining labels, adhesives or other surface imperfections.

.7 Remove all paint spots or overspray from all affected surfaces.

.8 Clean and polish all glass and mirrors. Replace broken, scratched or disfigured glazing. Remove remaining manufacturer's and safety "X" labels.

.9 Clean and polish all finished metal surfaces such as enamelled or stainless steel, chrome, aluminum, brass, and bronze.

.10 Clean and polish all vitreous surfaces such as plumbing fixtures, ceramic tile, porcelain enamel, or other such materials.

.11 Clean all ceramic tile surfaces in accordance with the manufacturer's instructions, and apply final coat of sealer where specified.

.12 Clean inside of all millwork and cabinetry.

.13 Vacuum, clean and dust behind grilles, louvres and screens.

.14 Seal and wax all resilient floor surfaces as specified, and as recommended by the manufacturer.

.15 Steam clean all carpets immediately prior occupancy by the City.

.16 Broom clean and spray wash all exterior paved surfaces.

.17 Remove dirt and other disfiguration from exterior surfaces.

.18 Clean all roofs, gutters, downspouts, areaways, drywells, and drainage systems.

.19 Clean all equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Overview of waste management recycling and disposal requirements and procedures.

.2 Preparation of a Construction Waste Management Plan (CWMP), in compliance with all applicable municipal, provincial or federal acts and regulations and the Leadership in Energy and Environmental Design (LEED) Reference Guide for Building Design and Construction Version 4 (LEED v4 BD+C).

.3 Provision of documentation on waste and recycling haulers, receivers and providers.

.4 Implementing and monitoring the Construction Waste Management Plan.

1.2 RELATED SECTIONS

.1 01 35 40 LEED Sustainable Design Requirements.

.2 01 57 13 Erosion and Sedimentation Control.

.3 In addition, all sections of this Specification are affected by this Section for effective waste reduction, reuse, recycling or disposal.

1.3 GENERAL REQUIREMENTS

.1 Implement a CWMP for all construction activities associated with the Project as per LEED v4 requirements.

.2 Implement and monitor the CWMP in compliance with all applicable municipal provincial or federal acts and regulations.

.3 Provide to the LEED Consultant all required documentation, receipts, tickets, waybills and other forms of evidence of construction waste management activities.

.4 Provide to the LEED Consultant all required documentation and contact information for local recycling and waste management receivers, haulers and providers for the project.

1.4 DEFINITIONS

.1 Alternative Daily Cover (ADC): Material other than earthen material placed on the surface of the active face of a municipal solid waste landfill to control litter, fire, odour, vectors and scavenging

.2 Clean Waste: Non-hazardous materials left over from construction and demolition. Clean wastes excludes lead, asbestos and hazardous materials

.3 Construction Waste: Materials that are man-made including those that were already on site

.4 Construction Waste Management Plan: The project specific document that outlines measures to divert construction waste materials from landfill and incineration facilities

.5 Divert: The action to prevent waste materials from going to landfill. Diverted materials may be reused or recycled at the end of their life.

.6 Hauler: A qualified entity contracted or otherwise engaged to remove waste material (including recyclables) from the project site

.7 Land-Clearing Debris: Natural materials resulting from land-clearing that include rock, soil, stone, vegetation. Such material is not counted towards waste diversion.

.8 Reused Waste: Waste materials sent to an off-site location (e.g. another construction project or supplier) for use in their original form (i.e. without additional processing).

.9 Recycled Waste: Waste materials sent off-site to an approved recycling facility to be used to displace virgin material feedstock in manufacturing processes to create new products.

.10 Landfill Waste: Waste materials sent to a landfill site for disposal.

.11 Reuse: Returning a material or thing to active use in the same manner or a related capacity as the original use

.12 Receiver: An entity, facility or provider receiving waste or recyclable material or materials

.13 Solid Waste: Any waste material (including land-clearing debris) sent from the project site to another location for disposal.

1.5 REFERENCES

.1 Canadian Construction Association. Standard Construction Document CCA 27-1997: A Guide on Construction Environmental Management Planning.

.2 Canadian Construction Association. Standard Construction Document CCA 81-2001: A Best Practices Guide to Solid Waste Reduction.

.3 Materials & Resources Credit: Construction Waste Management. LEED Reference Guide for Building Design and Construction Version 4 and Version 4.1 (LEEDv4 BD+C).

1.6 REQUIREMENTS

.1 Minimize the amount of solid waste generated by construction, renovation, and demolition activities.

.2 Prepare a Construction Waste Management Plan (CWMP) to divert at least five (5) material streams and a minimum of 75% of construction waste generated by the project.

.3 Identify the anticipated weight of each material stream to be diverted (recycled) and the anticipated weight of total waste to be generated.

.4 Specify that diverted materials will be weighed individually by waste stream if comingled.

.5 Describe the exact destination to which the materials will be taken (Receiver).

.6 Provide an End of Life management letter from each Receiver detailing how the specific individual material will be processed for future use.

.7 Comply with all applicable municipal, regional and county construction waste management regulations as apply to the geographical jurisdiction of the project.

.8 Record each shipment using the LEED Construction and Demolition Waste Calculator.

.9 Provide to the LEED Consultant monthly records, receipts, tickets, waybills, and other documentation as required to verify construction waste management and recycling activity.

1.7 DESCRIPTION OF WORK

.1 The Contractor shall designate a party to be responsible for all aspects of Waste Management and Disposal.

.2 Identify, implement and document measures to achieve the waste management objectives and requirements listed above.

.3 Follow a strategy based on the 3R’s hierarchy:

.1 Reduce generation of waste materials at the project site,

.2 Reuse waste materials (when feasible), and

.3 Recycle waste materials as feedstock for manufacturing processes.

.4 Recycle, salvage, return or reuse construction waste materials and products of demolition and provide facilities as necessary to keep them appropriately separated and protected from contamination or otherwise being wasted.

.5 Contractors Waste Management and Disposal responsibilities shall include:

.1 Identifying and retaining a waste Hauler (or Haulers) for all targeted wastes

.2 Preparing waste management submittals as required to summarize the diversion from landfill of all loads of waste materials from the project to appropriate receiving sites, as approved by the LEED Consultant prior to construction start.

.3 Reporting waste management progress to the LEED Consultant including up-to-date summary sheets (indicating current diversion totals, materials, dates, and photos). Failure to submit will delay progress payments.

.6 Issue the CWMP as approved by the LEED Consultant prior to commencement of Work.

.7 Regularly assess the effectiveness and compliance of waste management procedures, controls, collection containers, and worker activities.

.8 Include the Construction Waste Management Plan in the Orientation of all site staff and workers and verify worker understanding of waste management requirements.

1.8 REGULATORY REQUIREMENTS

.1 Comply with all provincial waste management requirements and all applicable regulations, codes and standards, with regards to environmental protection measures.

.2 Be aware of all regulations affecting activities on site and comply with all requirements.

.3 Assume all responsibilities and obligations described by the accepted CWMP.

.4 Implement measures of the CWMP for the duration of the Contract. During cessation of activity due to winter shutdown, continue to provide inspection and maintenance measures in accordance with the CWMP.

.5 Construction work will be suspended if regulatory requirements are not complied with. No extra compensation or extension of time for the Contract will be allowed.

.6 Regularly inspect, maintain and repair/replace as necessary, waste management infrastructure, and signage, as required and in a manner acceptable to the LEED Consultant.

1.9 SUBMITTALS

.1 Comply with submittal requirements specified in Section 01 35 40 LEED Sustainable Design Requirements and Section 01 60 13 LEED Product Requirements.

.2 Prior to construction start, submit a list of Haulers and Receiving sites for diverted construction materials.

.3 Prior to construction start, provide a reasonable estimate of probable diversion rates from an experienced and licensed waste Hauler, targeted receiving facilities, and a sample of the Hauler's LEED waste diversion documentation.

.4 List of targeted materials and corresponding Receiving facilities and include an estimate of quantity to be diverted for the entire project.

.5 End-of-life material management letters or declarations from each Receiver.

.6 Waybills, invoices, letters, scale tickets, and other documentation as applicable that clearly indicates the receiving facility, end use (reused, recycled or landfill) and quantity of waste for each shipment of waste generated on the project site.

.7 Monthly waste summary documentation. Failure to submit may delay progress claim.

2 Products

NOT USED

3 Execution

3.1 PROCEDURES

.1 Waste Reduction

.1 Workers shall remove wastes generated by their own activities off-site for disposal.

.2 Suppliers and subcontractors shall retain packaging for reuse.

.3 In the event a worker removes from site and uses a waste material for another purpose, the worker must provide an invoice, letter, or other documentation indicating Receiver, date, end use, type, and quantity of waste removed from site.

.4 Prevent damage of materials due to contamination, mishandling, and improper storage, protection and installation.

.5 Designate a central waste storage on site dedicated to separation and storage of materials into appropriately marked and secured bins during construction.

.6 Divert and recycle at a minimum the following materials:

.1 Wood

.2 Concrete

.3 Metals

.4 Drywall

.5 Paper and Cardboard

.7 All workers shall use the designated containers in the waste collection area.

.8 Follow the Receivers' material acceptance requirements to ensure materials are properly prepared (sorted, grouped, packaged) for collection.

3.2 INSPECTIONS AND MAINTENANCE

.1 Inspect waste containers to check for and remedy cross-contamination daily.

.2 Inspect and photograph any waste bin to be removed on the day of removal prior to removal by the waste hauler.

.3 Promptly transport containers to receiving facilities when containers are full.

.4 Clearly label the material type on each container in the required language(s).

END OF SECTION

1 General

1.1 GENERAL INSTRUCTIONS

1. The procedures for completing Contract and acceptance by the City shall be in accordance with the methods prescribed by the City.
2. Stages will be reviewed at the Contract start-up meeting to ensure that parties understand their responsibilities. Refer to Section 01 31 19 – Project Meetings for procedures and requirements for Contract start-up meeting.
3. Within four (4) weeks of commencement of the Work, submit to the Contract Administrator a list of closeout submittals required by the Contract Documents.
4. Note that entities other than the City may be involved in the closeout procedures described herein, including attendance at any operation and/or maintenance training sessions required. The City will coordinate such attendance as required.

1.2 FINAL CLEANING

1. Co-ordinate final clean-up with the City's representatives and opening requirements.
2. In addition to requirements for cleaning-up specified in the General Conditions of the Contract, and in Section 01 11 00 – Summary of Work, include in work final cleaning by skilled cleaning specialists on completion of construction.
3. Remove temporary protections and make good defects before commencement of final cleaning.
4. Refer to Section 01 74 00 – Cleaning and Waste Processing
5. Replace materials that have been broken, damaged, scratched and/or etched during construction, or which are otherwise defective.
6. Remove dust, stains, paint spots, soil, grease, fingerprints, and accumulations of construction materials, interior and exterior to the building. Perform cleaning in accordance with installer's instructions for each material. Final cleaning shall include:
    1. Washing of interior concrete floors.
    2. Cleaning and polishing of:
        1. glass;
        2. porcelain, and finish metals;
    3. Vacuum cleaning of ceilings, walls and floors.
    4. Cleaning of glazed wall surfaces.
    5. Cleaning of hardware, mechanical fixtures, lighting fixtures, cover plates, and equipment, including polishing of their finish metal, porcelain, vitreous, and glass components.
    6. Removing of visible labels left on materials, components, and equipment.
    7. Maintain cleaning until the City has taken possession of building or portions thereof.

1.3 CLOSE-OUT SUBMITTALS

1. Collect reviewed submittals, and assemble required closeout submittals executed by Subcontractors, Suppliers, and manufacturers. Prior to submitting closeout submittals to the Contract Administrator, undertake the following:
    1. Review maintenance manual contents (operating, maintenance instructions, as built drawings, materials) for completeness.
    2. Review in relation to Contract Price, Change Orders, Change Directives, holdbacks and other adjustments to the Contract Price.
    3. Review inspection and testing reports to verify conformance to intent of Contract Documents and that changes, repairs or replacements have been completed.
    4. Execute transition of performance bond and labour and materials payment bond to warranty period requirements.

5. Submit a final statement of accounting giving total adjusted Contract Price, previous payments, and monies remaining at time of application for completion of the Contract. Contract Administrator will issue a final change order reflecting approved adjustments to Contract Price not previously made, if any.

2. No later than then fifteen (15) working days prior to submitting request for Contract Administrator's review to determine if Substantial Performance of the Work has been achieved, submit to the Contract Administrator the closeout submittals specified in this section, including, but not limited to, reviewed shop drawings, Product data sheets, samples, operating instructions, as-built records, and fully executed warranties and guarantees.
3. For items of the Work delayed materially beyond date of Substantial Performance of the Work, provide updated closeout submittals within ten (10) working days after acceptance, listing date of acceptance as start of warranty period.
4. Neither the Contract Administrator's review to determine if Substantial Performance of the Work has been achieved, nor acceptance of the Work, will take place until receipt, by the Contract Administrator, of acceptable copies of the closeout submittals required herein and by the Contract Documents.
5. As-built records and operation and maintenance manuals, as indicated in Section 01 33 00 – Submittal Procedures.
6. Maintenance materials:
    1. Deliver to a location and at a time specified by the City, organize items in the City's storage area as directed by the City, and as follows:
        1. Use unbroken cartons, or if not supplied in cartons, material shall be strongly packaged.
        2. Clearly mark cartons or packaging as to contents, project name, and Supplier.
        3. If applicable give colour and finish, room number or area where material is used.
    2. Replace incorrect or damaged maintenance materials delivered to the City, including damage through shipment.
    3. Provide a typed inventory list of maintenance materials prior to Substantial Performance of the Work application. List all items, complete with quantities, and storage locations.
    4. Establish a master list identifying maintenance materials and maintain a log of when materials are turned over to the City and signing authority for acceptance of materials on behalf of the City. Master list and log shall be in a format acceptable to the City.
7. The City communication material:
    1. Deliver the City communication material that was applied to hoarding and/or temporary barriers and enclosures during the Work. Salvage such material in accordance with Section 01 11 00 – Summary of Work.

1.4 SUBSTANTIAL PERFORMANCE OF THE WORK

1. Deficiency review:
    1. Neither the City nor Contract Administrator will be responsible for preparation or issuance of extensive lists of deficiencies. Contractor assumes prime responsibility for ensuring that items shown and described in the Contract Documents are complete. Any reviews to approve the certificate of Substantial Performance of the Work will be immediately cancelled if it becomes obvious to the Contract Administrator that extensive deficiencies are outstanding.
    2. The Contractor shall conduct an inspection of the Work to identify deficiencies and defects, which shall be repaired. When the Contractor considers that the Work is substantially performed, the Contractor shall prepare and submit to the Contract Administrator a comprehensive list of items to be completed or corrected and apply for a review of the Work by the Contract Administrator to determine if Substantial Performance of the Work has been achieved.

3. The Contractor's request described above shall include a statement by Contractor that the Work to be reviewed by Contract Administrator for deficiencies is, to the best of the Contractor's knowledge, in compliance with Contract Documents, reviewed shop drawings, and samples, and that deficiencies and defects previously noted by Contract Administrator have been repaired.
4. No later than fifteen (15) Working days after the receipt of the Contractor's request described above, but contingent upon the prior receipt, by the Contract Administrator, of the closeout submittals in the manner and form specified in this section, the Contract Administrator and the Contractor will review the Work to identify any defects or deficiencies. If necessary, the Contractor shall tabulate a list of deficiencies to be corrected prior to Substantial Performance of the Work being certified by the Contract Administrator.
5. During review, the Contract Administrator and the Contractor will decide which deficiencies or defects must be rectified before Substantial Performance of the Work can be certified, and which defects are to be treated as warranty items.
6. Provide a schedule of planned deficiency review having regard to the foregoing.

2. Certification of Substantial Performance of the Work:

    1. When the Contract Administrator considers that the deficiencies and defects have been completed and that it appears that the requirements of the Contract Documents have been substantially performed, the Contract Administrator shall issue a certificate of Substantial Performance of the Work to the Contractor, stating the date of Substantial Performance of the Work.

3. Final Inspection for completion of the Contract:

    1. Deficiencies and defects shall be made good before the Contractor submits a written request for final review of the Work and before the Contract is considered complete.
    2. When Contractor is satisfied that the Work is complete, and after the Contractor has reviewed the Work to verify its completion in accordance with the requirements of the Contract Documents, the Contractor shall submit a written request for a final review by the Contract Administrator, who in turn will notify the City.
    3. If there are any deficiencies identified as a result of this review, they shall be listed by the Contract Administrator and submitted to the Contractor. This list shall be recognized as the final deficiency list for purposes of acceptance of the Work under the Contract.
    4. Such deficiencies shall be corrected by a date mutually agreed upon between Contract Administrator and the Contractor, unless a specific date is required by Contract, and a further review by the Contract Administrator shall be called for by the Contractor following his own review to take place within seven (7) days from date of request.
    5. Contractor shall thereafter submit invoice for final payment.
    6. Money shall be withheld for deficiency work and will be released only when all deficiencies have been completed. No partial payment to be recognized until all work is completed.

4. If the Contractor needs to return to the Place of the Work to complete deficiencies after the City has taken possession, the Contractor shall provide the City with a minimum of one (1) week's prior notice of such requirement.

1.5 WARRANTY PERIOD

1. Provide on-going review and attendance to call-back, maintenance, and repair problems during the warranty periods.

2. At the beginning of the 12th month after Substantial Performance of the Work, the City, Contractor, and Contract Administrator, along with key Subcontractors as designated, shall carry out a complete review of the built project to determine which deficiencies are to be rectified under the warranty.

3. Contractor shall be responsible for timely written notification of the City, and Contract Administrator a minimum of three (3) months prior to such end of warranty period inspection and any delay in such notification shall extend such warranty period until proper notification is received by the City, and Contract Administrator.

2 Products

2.1 NOT USED

3 Execution

3.1 NOT USED

END OF SECTION

1 General

1.1 SUBMISSION

1. Prepare instructions, drawings and data using personnel experienced in maintenance and operation of described products.
2. Revise content of documents as required prior to final submittal.
3. Pay costs of shipping.
    1. As-Built Documents: To Contract Administrator's business address.
    2. Spare Parts, Maintenance Materials, and Special Tools: To site.
4. The amount of as built documents and operational and maintenance manuals is valued at 0.5% of the Contract Pirce for the purposes of determining Substantial Performance.

1.2 AS-BUILT DOCUMENTS

1. Obtain from the Contract Administrator and pay cost for one copy of Specifications and one set of white prints of the Contract Drawings at the commencement of Work, and, prior to the date of Substantial Performance, an extra set of white prints of Contract Drawings, for as-built purposes.
2. Maintain record documents in clean, dry, and legible condition. Do not use record documents for construction purposes.
3. As Work progresses, clearly mark in a neat and legible form with red ink on Specifications and drawing white prints all significant changes and deviations from the Contract Drawings and Specifications caused by site conditions, Supplemental Instructions and Change Orders.
    1. Changes and deviations marked on as-built record drawings and specifications by reference to Supplemental Instructions, Change Orders and other documents are not acceptable.
4. Record the following changes and deviations on drawing white prints:
    1. Depths of various elements of foundation in relationship to the first-floor level.
    2. Field changes of dimensions.
    3. Changes made by Addenda and change orders.
    4. Details not on original Contract Drawings.
    5. Other significant deviations and changes which are concealed in construction and cannot be identified by visual inspection.
5. Show actual locations of the following on drawing white prints:
    1. Access doors and panels.
    2. Inverts of services at key points within the building, at points where entering and leaving the building, and at the property lines. Dimension services in relation to the structure and building grid lines.
    3. Measured horizontal and vertical locations of site utilities and appurtenances, referenced to permanent surface improvements.
    4. Ductwork, piping, conduit, mechanical and electrical equipment, and associated work.
    5. Concealed piping, conduit, and equipment, including such items provided for future use.
6. Record the following information on the Specifications.
    1. Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

2. Changes made by Addenda and change orders.
3. Accepted substitutions and alternatives.
4. Other approved changes and deviations to items specified.

7. Have white prints and specifications available for review at all times.
8. Final As Built Drawings: Prior to the date of Substantial Performance, allowing for Contract Administrator's review, clearly, neatly, and accurately transfer information from the marked-up drawing white prints to a set of clean white prints.
   1. Print lettering and numbers in size to match original.
   2. Lines may be drawn free hand, provided they are neat and accurate. Add "AS-BUILT RECORD" at each drawing title block. Should extensively changes and deviations to a drawing make the information illegible, re-draft the changed areas as required.
   3. Submit drawing white prints made containing as-built record information for Contract Administrator's review. Correct as directed by Contract Administrator.
   4. Submit finalized as-built record drawing transparencies and as-built record specifications to the Contract Administrator two weeks prior to application for Certificate of Substantial Performance.

1.3 OPERATING AND MAINTENANCE MANUAL

1. Six weeks prior to application for Certificate of Substantial Performance of the Work, submit to the Contract Administrator, three final copies of operating and maintenance manuals in English.
2. Organize data in the form of an instructional manual.
3. Binders: vinyl, hard covered, 3 D ring, loose leaf 219 mm x 279 mm (8-1/2"x 11") with spine and face pockets.
4. When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
5. Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
6. Table of Contents, each binder: Provide title of project:
   1. date of submission; names,
   2. addresses, and telephone numbers of Contract Administrator and Contractor with name of responsible parties;
   3. schedule of products and systems, indexed to content of volume.
7. Arrange content by systems, under Section numbers and sequence of Table of Contents.
8. Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
9. Text: Manufacturer's printed data, or typewritten data.
10. For each product or system: List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
11. Product Data and Shop Drawings: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.
12. Other Documents: Maintain manufacturer's certifications, inspection certifications, field test records, survey plans, required by individual specifications sections.

13. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
    1. Provide CD including digital BIM drawings on one of the following formats:
        1. 1:1 scaled CAD files in dwg format.
14. Equipment and Systems
    1. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
    2. Panel Board Circuit Directories: Provide electrical service characteristics, controls, and communications.
        1. Include installed colour coded wiring diagrams.
    3. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
    4. Maintenance Requirements: Include routine procedures and guide for troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
    5. Provide servicing and lubrication schedule, and list of lubricants required.
    6. Include manufacturer's printed operation and maintenance instructions.
    7. Include sequence of operation by controls manufacturer.
    8. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
    9. Provide installed control diagrams by controls manufacturer.
    10. Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
    11. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
    12. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
    13. Additional requirements: As specified in individual specification sections.
15. Materials and Finishes
    1. Building Products, Applied Materials, and Finishes: Include product data, with catalogue number, size, composition, and colour and texture designations.
    2. Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
    3. Moisture-protection and Weather-exposed Products: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
    4. Additional Requirements: As specified in individual specifications sections.

1.4 STORAGE, HANDLING AND PROTECTION

1. Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
2. Store in original and undamaged condition with manufacturer's seal and labels intact.
3. Store components subject to damage from weather in weatherproof enclosures.

4. Store paints and freezable materials in a heated and ventilated room.
5. Remove and replace damaged products at own expense and to satisfaction of Contract Administrator.

1.5 WARRANTIES AND BONDS

1. Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
2. List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
3. Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.
4. Except for items put into use with the City's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.
5. Verify that documents are in proper form, contain full information, and are notarized.
6. Co-execute submittals when required.
7. Retain warranties and bonds until time specified for submittal.

2 Products

2.1 MATERIALS

1. Provide new spare parts, maintenance materials and special tools, undamaged or defective, and of same quality and manufacture as products provided in the Work.
2. Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
3. If requested, furnish evidence as to type, source and quality of products provided.

2.2 SPARE PARTS AND MAINTENANCE MATERIALS

1. Provide spare parts, maintenance and extra materials in quantities specified in individual specification sections.
2. Provide items of same manufacture and quality as items in Work.
3. Deliver to site, place, and store.
4. Receive and catalogue all items. Submit inventory listing to Contract Administrator. Include approved listings in Operating and Maintenance Manuals.
5. Obtain receipt for delivered products and submit prior to final payment.

2.3 SPECIAL TOOLS

1. Provide special tools, in quantities specified in individual specification section.
2. Provide items with tags identifying their associated function and equipment.
3. Deliver to site, place and store.
4. Receive and catalogue all items. Submit inventory listing to Contract Administrator. Include approved listings in Operating and Maintenance Manuals.

3 Execution

3.1 TAKEOVER PROCEDURES

1. Conform to AIBC Professional Standards for takeover procedures, subject to amendments by this Section.

2. Contractor's Inspection: Contractor shall conduct an inspection of the Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.

3. Request for Substantial Performance Inspection: Notify Contract Administrator in writing of satisfactory completion of Contractor's inspection and that corrections have been made and request Contract Administrator's inspection.

    1. Work has been completed and inspected for compliance with Contract Documents.

    2. Defects have been corrected, and deficiencies have been completed.

    3. Equipment and systems have been tested, adjusted, and balanced and are fully operational.

    4. Certificates required by the authorities having jurisdiction and utility companies have been submitted.

    5. Operation of systems have been demonstrated to the City’s personnel.

    6. Work is complete and ready for Substantial Performance inspection.

4. Contract Administrator's Inspection: Contract Administrator and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.

5. When Contract Administrator considers deficiencies and defects have been corrected and it appears requirements of Contract have been performed, make application for certificate of Substantial Performance.

    1. Submit a statement of accounting giving total adjusted Contract Price, previous payments, and monies remaining due.

    2. Contract Administrator will issue a final change order reflecting approved adjustments to Contract Price not previously made.

6. Application for Release of Holdback: After issuance of Certificate of Substantial Performance of Work, submit an application for payment of holdback amount. Submit a statement of accounting giving holdback monies due under lien legislations.

END OF SECTION

1 General

1.1 RELATED DOCUMENTS

1. C13 Warranty.

1.2 WARRANTIES

1. Warranties shall be in accordance with the General Conditions, as amended, and as follows:
    1. Warranties shall commence at date of Substantial Performance of the Work.
    2. Submit warranties for applicable items, signed by the applicable company responsible for each warranty.
    3. Submit warranties on form approved by the City including, but not limited to, the following information:
        1. Name and address of Project.
        2. Warranty commencement date (date of Substantial Performance of the Work).
        3. Duration of warranty.
        4. Clear indication of what is being warranted and what remedial action will be taken under warranty.
        5. Authorized signature and seal of company providing each warranty.
    4. The City shall be named in manufacturer's Product warranties.

2 Products

2.1 NOT USED

3 Execution

3.1 NOT USED

END OF SECTION

1 General

1.1 DESCRIPTION

1. Demonstrate operation and maintenance of equipment and systems to the City's personnel four weeks prior to date of Substantial Performance.
2. The City will provide list of personnel to receive instructions and will coordinate their attendance at agreed-upon times.

1.2 QUALITY ASSURANCE

1. Instructor Qualifications: Factory authorized service representative, experienced in operation and maintenance procedures and training.
2. Pre-Instruction Meeting: Conduct meeting at Project site to review methods and procedures related to demonstration and training including, but not limited to, the following:
    1. Inspect and discuss locations and other facilities required for instruction.
    2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
    3. Review required content of instruction.
    4. For instruction that must occur outdoors, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.3 SUBMITTALS

1. Submit in accordance with Section 01 33 00 – Submittal Procedures.
2. Instruction Program: Submit three copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
    1. At completion of training, submit three complete training manuals for the City's use.
3. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 COORDINATION

1. Coordinate training schedule with the City's operations. Adjust schedule as required to minimize disrupting the City's operations.
2. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
3. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Contract Administrator.

1.5 CONDITIONS FOR DEMONSTRATIONS

1. Equipment has been inspected and put into satisfactory operation.
2. Testing, adjusting, balancing, and commissioning have been performed, and equipment and systems are fully operational.

2 Products

2.1 INSTRUCTION PROGRAM

1. Program Structure: Develop an instruction program that includes individual training modules for all systems and equipment not part of a system, including and not limited to:
    1. Motorized doors.
    2. Electrically operated equipment.
    3. Fire-protection systems.
    4. Security systems.
    5. Lift systems.
    6. HVAC systems.
    7. HVAC instrumentation and controls.
    8. Plumbing systems
    9. Industrial systems
    10. Electrical service and distribution
    11. Packaged engine generator
    12. Lighting equipment and controls
    13. EV Charging System (Battery Electric Bus)
    14. Fire alarm system
    15. Communication systems
2. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following, as applicable:
    1. Operational Requirements and Criteria:
        1. System, subsystem, and equipment descriptions.
        2. Performance and design criteria if Contractor has delegated design responsibility.
        3. Operating standards.
        4. Regulatory requirements.
        5. Equipment function.
        6. Operating characteristics.
        7. Limiting conditions.
        8. Performance curves.
    2. Emergencies:
        1. Instructions on meaning of warnings, trouble indications, and error messages.
        2. Instructions on stopping.
        3. Shutdown instructions for each type of emergency.
    3. Operations:
        1. Startup procedures.
        2. Equipment or system break-in procedures.

3. Routine and normal operating instructions.
4. Operating instructions for conditions outside of normal operating limits.
5. Regulation and control procedures.
6. Control sequences.
7. Safety procedures.
8. Normal shutdown instructions.
9. Operating procedures for system, subsystem, or equipment failure.
10. Seasonal and weekend operating instructions.
11. Required sequences for electric or electronic systems.

4. Adjustments:
    1. Alignments.
    2. Checking adjustments.
    3. Noise and vibration adjustments.
    4. Economy and efficiency adjustments.
5. Troubleshooting:
    1. Diagnostic instructions.
    2. Test and inspection procedures.
6. Maintenance:
    1. Inspection procedures.
    2. Types of cleaning agents to be used and methods of cleaning.
    3. List of cleaning agents and methods of cleaning detrimental to product.
    4. Procedures for preventive maintenance.
    5. Procedures for routine maintenance.
    6. Instruction on use of special tools.
7. Repairs:
    1. Diagnosis instructions.
    2. Repair instructions.
    3. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    4. Instructions for identifying parts and components.
    5. Review of spare parts needed for operation and maintenance.

3 Execution

3.1 PREPARATION

1. Verify that conditions for demonstration and instructions comply with requirements.
2. Verify that designated personnel are present.

3.2 DEMONSTRATION AND TRAINING

1. Delivery demonstration and training of each item of equipment at scheduled times, at the designated location.
2. Instruct the City's personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
3. Review contents of manual in detail to explain all aspects of operation and maintenance.
4. Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

3.3 EVALUATION AND CLEANUP

1. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written performance-based test.
2. Cleanup: Collect used and leftover educational materials and give to the City. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.4 TIME ALLOCATION

1. Ensure amount of time required for demonstration and training of each item of equipment or system as follows:
    1. Heating Plant: 8 hours.
    2. Cooling and Ventilation System: 8 hours.
    3. Control System: 16 hours.
    4. Plumbing System: 8 hours.
    5. Communication / Security System: 8 hours.
    6. Electrical service and distribution: 8 hours.
    7. Packaged engine generator: 4 hours.
    8. EV Charging System: 16 hours.
    9. Lighting equipment and controls 8 hours.
    10. Fire alarm system: 8 hours.
    11. Lifts: 4 hours.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Overview of indoor air quality (IAQ) management requirements and procedures, including product/material selection, storage, handling, protection and installation.

1.2 RELATED SECTIONS

.1 01 35 40 LEED Sustainable Design Requirements

.2 01 60 13 LEED Product Requirements

1.3 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition. ANSI/SMACNA 008-2008 Chapter 3.

.2 ANSI/ASHRAE 52.2-2017: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI Approved).

.3 LEEDv4 Indoor Environmental Quality Credit: Construction IAQ Management Plan: During Construction"

.4 Leadership in Energy and Environmental Design (LEED) Reference Guide for Building Design and Construction (LEED BD+C) Version 4 and 4.1.

.5 Construction Technology Centre Atlantic. Indoor Air Quality: A Facility Manager's Guide.

1.4 OBJECTIVES

.1 Meet or exceed the recommended Design Approaches of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd Edition. ANSI/SMACNA 008-2008, Chapter 3.

.2 Protect construction workers and future building occupants from indoor air quality problems resulting from construction activities.

.3 Reduce the production and circulation of pollutants during construction.

.4 Protect equipment and absorptive materials stored and installed on site from moisture, dust and dirt accumulation during construction.

.5 Prepare the building for occupancy following construction and prior to occupancy.

1.5 DESCRIPTION OF WORK

.1 The Contractor designate shall be responsible for all aspects of LEED coordination during construction related to indoor air quality management and execution of the Indoor Air Quality Management Plan.

.2 Indoor air quality management activities shall include:

.1 Identify, implement and document measures to achieve the indoor air quality management objectives.

.2 Supervise on-site indoor air quality management activities on a daily basis.

.3 Coordinate indoor air quality management tasks with workers to ensure timely and orderly progress of the work.

.4 Conduct indoor air quality management inspections once absorbent materials or HVAC components are brought on site and take necessary mitigation.

.5 Maintain an indoor air quality inspection log to document observations, deficiencies and corrective actions.

.6 Prepare indoor air quality management documentation and submittals.

.7 Report indoor air quality management progress to the Contract Administrator.

1.6 SUBMITTALS

.1 IAQ Inspection Report

.1 Complete an IAQ Inspection Report on a weekly basis through to building turnover. Commence once absorbent materials or HVAC components are brought on site.

.2 Complete an IAQ Inspection Report weekly and document:

.1 Indoor air quality management measures implemented onsite

.2 Deficiencies related to IAQ control measures and,

.3 Corrective actions taken to remedy the deficiencies

.1 Each deficiency must be initialed and each Report signed after all corrective measures have been completed and documented.

.3 IAQ Inspection Report must include date stamped photos of IAQ controls in place at time of inspection.

.4 Each photograph must reference the SMACNA indoor air quality management measure photographed.

.5 Submit completed IAQ Inspection Reports to the LEED Consultant monthly.

.2 Photograph Requirements

.1 Provide photographs as specified in the Specifications.

.2 Photographs must be date stamped.

.3 Photographs must correspond to the SMACNA indoor air quality management measure in the IAQ Inspection Report.

.3 Comply with submittal requirements specified in the Specifications.

2 Products

2.1 FILTRATION MEDIA REQUIREMENTS

.1 Air filter minimum efficiency reporting value (MERV) ratings shall be determined by ASHRAE 52.2-2017.

.2 Air handling equipment not used during construction shall be equipped with filters as specified.

.3 Air handling equipment used during construction shall be equipped with minimum MERV 8 prefilter/return and minimum MERV 13 final/supply filter before the system is operated.

.4 Comply with requirements of Section 01 35 40 LEED Sustainable Design Requirements.

2.2 SOURCE CONTROL – VOC PRODUCTS

.1 All VOC containing products used within the building must comply with the VOC content and emissions limits for that product category:

.1 Inherently non-emitting products must have documentation verifying they do not include integral organic-based surface coatings, binders, or sealants.

.2 Adhesives and sealants wet applied on site must meet the limits for VOC content of South Coast Air Quality Management District (SCAQMD) Rule #1168 October 6, 2017.

.3 All paints and coatings must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method V1.2-2017, using the applicable exposure scenario.

.4 All paints and coatings wet applied on site must comply with the VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule #1113 effective February 5, 2016.

.2 Flooring and flooring systems must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.2-2017 using the applicable exposure scenario.

.3 Composite wood, as defined by California Air Resources Board, Airborne Toxic Measure to Reduce Formaldehyde Emissions from Composite Wood Products Regulations must be documented to have low formaldehyde emissions that meet the California Air Resources Board ATCM for formaldehyde requirements for ultra-low emitting formaldehyde (ULEF) resins or no added formaldehyde (NAF) resins.

3 Execution

3.1 POLLUTION SOURCE IDENTIFICATION

.1 Identify potential sources of indoor air pollutants on the construction site.

3.2 POLLUTANT MINIMIZATION

.1 Minimize pollutants generated inside the building using the following measures:

.1 Prohibit smoking inside, on, under, and near the building at all times during construction.

.2 Fuel equipment outside the building.

.3 Store gasoline or solvents outside the building.

.4 Restrict outdoor vehicular/equipment traffic and operation where emissions can enter the building.

.5 Reduce on-site emissions by using equipment that burns propane/natural gas or is powered by electricity.

.6 Exhaust pollutant sources directly outside using temporary or permanent ventilation equipment. Where exhaust is not feasible, locally re-circulate air through a portable air cleaner.

.7 Collect and bag sawdust from woodworking tools.

.8 Cover and/or seal all indoor sources of odour and dust.

.9 Use painting techniques that minimize odour (e.g roller instead of spraying).

.10 Use cleaning practices that minimize dust (e.g. vacuum instead of sweeping).

.11 Use cleaning products that minimize pollution, fumes, VOC’s, etc.

3.3 PATHWAY INTERRUPTION

.1 Prevent movement of pollutants to areas in the building using the following measures:

.1 When possible, perform pollutant generating activities outside the building.

.2 Move equipment, work and other pollutant sources to locations where they will have the minimum impact on indoor air quality.

.3 Set up small, contained, designated work areas to contain pollutants:

.1 Avoid open areas and areas with high drafts

.2 Erect dust curtains and barriers

.3 Depressurize areas using temporary or permanent ventilation equipment

.4 Use portable fans to exhaust pollutants to the exterior through openings. Ensure adjacent openings will not allow pollutants to re-enter the building.

.5 Temporarily seal exterior openings until final installation is complete.

.6 Pressurize occupied or completed areas using ventilation equipment.

3.4 HOUSEKEEPING

.1 Prevent accumulation of moisture, dust, and dirt in the building using the following measures:

.1 Frequently cleaning interior surfaces to minimize dust and dirt accumulation by:

.1 Dust with damp rags

.2 Wet mop

.3 Sweep using wetting agents and sweeping compounds

.4 Vacuum with equipment that has HEPA filtration and/or a wet scrubber

.2 Localized cleaning immediately after construction activity is completed and/or at end of each day.

.3 Perform a full building clean-up at least once a week.

.4 Close exterior windows and doors or create temporary enclosures to prevent moisture accumulation indoors.

.5 Immediately remove any water accumulated indoors.

.6 Cover, seal and protect materials from moisture, dust and dirt accumulation.

.7 Elevate materials stored on-site off the ground.

.8 Do not install materials with moisture damage or moisture accumulation.

.9 Use ventilation/dehumidification to control humidity levels within the building.

.10 Promptly clean all spills.

.11 Clean or remove excess application of VOC-containing products.

3.5 HVAC PROTECTION

.1 During/Before Installation

.1 Cover and elevate all ductwork, fittings, insulation, acoustic lining and equipment stored on site during construction.

.2 Seal all supply, return, and exhaust openings and all temporary ductwork openings not under immediate work.

.3 Seal openings immediately after installation in areas no longer under work.

.4 Secure all hatches and access doors in HVAC equipment not undergoing work.

.5 Seal all HVAC equipment openings until ductwork is connected.

.6 Do not use mechanical rooms to store or collect construction waste materials.

.2 After Installation (select Option 1 or Option 2 for each HVAC system)

.1 Option 1: HVAC Equipment Not Used During Construction

.1 Do not operate permanent HVAC equipment or systems during construction.

.2 Seal all openings in HVAC systems, ductwork and plenums as described in paragraph 3.5.1 above.

.3 If HVAC system protection measures are not implemented, or if the system is operated during construction, provide duct cleaning, plus all necessary access doors, at no extra cost to the contract.

.4 After construction and final cleaning work is complete:

.1 Remove all HVAC protection measures

.2 Install new filters in air handling equipment as per paragraph 2.1

.3 Start up systems

.4 Prepare systems for Testing, Adjusting and Balancing Contractor and Commissioning Agent.

.2 Option 2: HVAC Equipment Used During Construction

.1 Install new filters in all air handling equipment as per article 2.1 before any HVAC system is operated. Provide a duct-mounted filter (external to equipment) if necessary.

.2 Install new filters with a minimum MERV 8 rating at all return/exhaust grilles/inlets before any HVAC system is operated.

.3 Temporarily shut down the return/exhaust side of HVAC systems during heavy construction/demolition.

.4 Permanently close off the return/exhaust side of HVAC systems in areas with high dust levels. Cover duct openings in these areas.

.5 If an HVAC system is operated without the above protection measures in place, provide duct cleaning, plus all necessary access doors, at no extra cost to the contract.

.6 After construction and final cleaning work is complete:

.1 Remove all temporary filters installed on return all grilles.

.2 Install new filters in air handling equipment as per article 2.1.

.3 Prepare systems for Testing, Adjusting and Balancing Contractor and Commissioning Agent.

3.6 PRE-OCCUPANCY IAQ MANAGEMENT PLAN – IAQ TESTING

.1 IAQ Testing (Indoor Air Quality Assessment) Prior to Occupancy

.1 Indoor air quality testing shall be carried out by a qualified IAQ testing Consultant at the expense of the Contractor.

.2 Contractor shall coordinate with IAQ testing Consultant the scope of the IAQ Testing protocol including spaces to be tested, times, durations, and stoppage of work.

.3 Contractor shall allow for all construction and final cleaning work to be complete prior to building occupancy for the IAQ testing Consultant to conduct indoor air quality testing.

.4 Contractor shall perform all corrective work related to general deficiencies, Testing, Adjusting, Balancing and Commissioning prior to indoor air quality testing.

.5 Contractor is responsible, if IAQ testing fails, to implement corrective measures to meet the requirements. Contractor is responsible for scheduling and expense of any necessary retesting of the building.

3.7 SCHEDULING

.1 Schedule construction activities to minimize VOC's, odors and fumes absorbed by porous materials.

.2 Complete application of wet and odorous materials such as paints, sealants, and coatings before installing absorbent materials.

.3 Allow for Testing, Adjusting and Balancing to be carried out following construction and before occupancy (refer to HVAC Protection Measures).

.4 Allow for corrective work related to general deficiencies, Testing, Adjusting and Balancing, and Commissioning to be carried out following construction and before occupancy.

3.8 INSPECTIONS AND MAINTENANCE

.1 Contractor shall inspect all indoor air quality management measures and remedy any deficiencies on a weekly basis.

.1 Complete the IAQ Inspection Report and denote measures implemented at time of inspection, any deficiencies, and corrective actions taken.

.2 Provide date stamped photos of all IAQ controls with each IAQ Inspection Report

.3 Conduct IAQ Inspections throughout construction to prove continuous compliance.

.2 IAQ protection measures will be reviewed by the Contract Administrator during site visits.

.1 Remedy and document mitigation of all deficiencies identified by the Contract Administrator within 48 hours of notification.

.2 Contractor shall clean or replace any impacted equipment or material at no extra cost to the contract.

3.9 REMOVAL OF PROTECTION MEASURES

.1 All products/materials installed as a part of indoor air quality management measures shall be removed prior to building turnover. Any remedial work required and cost incurred as a result of removing the measures is the responsibility of the Contractor.

END OF SECTION

1 General

1.1 RELATED DOCUMENTS

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

.2 Related Specification Sections:

.1 Division 01 General Requirements

.2 Division 21 Fire Suppression

.3 Division 22 Plumbing

.4 Division 23 HVAC

.5 Division 25 Integrated Automation

.6 Division 26 Electrical

.7 Division 28 Electronic Safety and Security

1.2 SUMMARY

.1 Section includes requirements and procedures for conducting equipment and system commissioning, including the following:

.1 Completion of commissioning procedures on specific equipment and systems as indicated under “Related Sections” above.

.2 Verification of operational and functional performance of specific equipment and systems for compliance with the City’s Project Requirements as described in the “Related Sections” above.

.3 This project is pursuing LEED Silver certification under LEED BD+C Version 4 Core & Shell.

.4 Fundamental Commissioning of all commissioned systems shall be accomplished through the review of the City’s project requirements and basis of design, review of construction documents, designation of the commissioning team, incorporating commissioning requirements into construction documents, implementing a commissioning plan, prefunctional system tests, functional performance tests and writing a summary commissioning report.

.5 Enhanced Commissioning of all commissioned systems shall be accomplished through the review of the City’s project requirements and basis of design, review of construction documents, review of contractor submittals, developing a systems manual for operating staff, verifying that building operations personnel are adequately trained, developing an ongoing commissioning plan, and conducting a building operations review prior to end of warranty.

.6 Monitoring Based Commissioning of all commissioned systems shall be accomplished through developing monitoring-based procedures and identifying points to be measured or evaluated to assess system performance, incorporating commissioning requirements into construction documents, and verifying calibration of related equipment and devices.

.7 Enclosure Commissioning of all commissioned systems shall be accomplished through the review of the City’s project requirements and basis of design, review of construction documents, designation of the commissioning team, incorporating commissioning requirements into construction documents, implementing a

commissioning plan, prefunctional system tests, functional performance tests, verifying that building operations personnel are adequately trained and conducting a building operations review prior to end of warranty, writing a summary commissioning report, and developing an ongoing commissioning plan.

.8 The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

1.3 DEFINITIONS

.1 BOD: Basis of Design

.2 Commissioning: The systematic process of ensuring that building's energy related systems are installed, calibrated and perform appropriately in accordance with the City's Project Requirements (OPR), engineer's basis of design (BOD), and as represented in the construction documents and specifications.

.3 Commissioning Authority (CxA): Independent entity responsible for overseeing the specified commissioning procedures and under contract directly with the City or Contract Administrator.

.4 Commissioning Report: Report prepared by the Commissioning Authority, detailing the commissioning procedures performed, inspection and testing results and the current version of the Issues Log indicating the process to resolve any outstanding issues.

.5 Functional Performance Testing: The process of testing and documenting system parameters under simulated or actual operating conditions.

.6 Installation and Startup Checklists: Installation and start-up items to be completed by the appropriate party prior to Functional Performance Testing.

.7 Issues Log: List of noted deficiencies discovered and corrective actions taken as a result of commissioning process.

.8 O&M: Operations and Maintenance

.9 OPR: Owner's (The City) Project Requirements

.10 Physical Inspection Process: On-site inspection and review of related system components for conformance to the specifications.

1.4 COORDINATION

.1 Commissioning Team (Abbreviations):

.1 Contract Administrator: Architect and Design Engineers – Design Team (A/E)

.2 Controls Subcontractor (CC)

.3 Commissioning Authority (CxA)

.4 Electrical Subcontractor (EC)

.5 Contractor (C)

.6 Mechanical, Electrical and Plumbing Subcontractors (MEP)

.7 The City (Owner) / Contract Administrator (OS)

.8 The City's designated Project Manager (PM)

.9 Testing and Balancing Subcontractor (TAB)

.2 Management: The CxA is hired by the City or Contract Administrator. The CxA directs and coordinates the commissioning activities. All members work together to fulfill their

contracted responsibilities and meet the objectives of the Contract Documents. The CxA's responsibilities are the same regardless of who hired the CxA.

.3 Scheduling: The CxA will work with and provide sufficient notice to the PM and GC to schedule commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling on an ongoing basis and make necessary notifications in a timely manner in order to expedite the commissioning process.

1.5 COMMISSIONING TEAM RESPONSIBILITIES

.1 The responsibilities of various parties in the commissioning process are provided in this section. It is noted that the services for the Project Manager, Construction Manager, Contract Administrator, HVAC mechanical and electrical designers/engineers are not provided for in this contract. That is, the Contractor is not responsible for providing their services. Their responsibilities are listed here to clarify the commissioning process.

.1 Design Team Responsibilities:

.1 Attend commissioning scoping meeting, controls integration meeting and additional meetings, as necessary.

.2 Complete the Basis of Design (BOD) documentation, assist with development of the City's Project Requirements (OPR) document and sequence of operation documentation as required by CxA.

.3 Perform normal submittal review, construction observation, as-built drawing preparation, etc., as contracted.

.4 Assist in resolution of system deficiencies identified during commissioning.

.5 Ensure adherence of the design to Regulations, Standards and Practices in execution and the product delivered.

.6 Review the constructed work, process changes if necessary and identify deficiencies in the contractors' work.

.7 Review and approve operations and maintenance manuals (O&M).

.2 Commissioning Authority (CxA) Responsibilities:

.1 As defined in the commissioning contract, as per LEED v4, provides the commissioning of the installation from the design phase to the completion operational cycle including the preparation of manuals, training oversight and sign off.

.2 Design, Construction and Acceptance Phase:

.1 Develop and coordinate execution of testing plan and commissioning activities to verify and document systems are functioning in accordance with design intent and Contract Documents.

.2 May assist with problem-solving of deficiencies, but ultimately that responsibility lies with the contractors and Contract Administrator of record.

.3 Not responsible for design concept, design criteria, code compliance, general construction scheduling, cost estimating, or construction management.

.4 Plan and conduct a commissioning scoping meeting and other commissioning meetings.

.5 Coordinate the commissioning work and, with the GC and PM, ensure that commissioning activities are being scheduled into the master schedule.

.6 Request and review additional information required to perform commissioning tasks, including contractor submittals, O&M materials, contractor start-up and checkout procedures.

.7 Concurrent with the A/E reviews, review contractor submittals of systems being commissioned for compliance with commissioning process,

.8 Perform site visits to observe component and system installations.

.9 Develop start-up and initial systems checkout plan with Subcontractors.

.10 Approve systems installation by reviewing Installation Checklists completed by the Contractor and subcontractors.

.11 Approve systems startup by reviewing start-up reports and by selected site observation.

.12 Review TAB execution plan.

.13 With necessary assistance and review from installing contractors, write the functional performance test procedures for equipment and systems. Submit to PM for review, and for approval if required.

.14 Coordinate, witness, document and approve functional performance tests performed by installing contractors. Coordinate retesting as necessary.

.15 With the GC and Subcontractors, maintain master deficiency and resolution record and provide the City with written progress reports and recommended actions. Additional costs to oversee, retest and correct deficiencies shall be paid by the GC.

.16 Review the O&M manuals.

.17 Prepare and deliver the systems manual to the City's operating staff.

.18 Verify contractor training of the City's operating personnel on the commissioned equipment and systems.

.19 Prepare a final commissioning report.

.20 Conduct a 10 month warranty review with the Facilities Representative to ensure that any warranty issues are identified prior to the end of the warranty period.

.21 Review building operation with the Facilities Representative over the first year of operation and develop a plan for resolving outstanding commissioning related issues including how occupants may report Internal Air Quality (IAQ) concerns, how these IAQ issues will be investigated/addressed, and how the results will be reported back to the occupants.

.22 Post occupancy operation commissioning, including delayed and seasonal testing and warranty issues, shall be performed as outlined in ANSI/ASGRAE/IES Standard 202-2013 section 16.

.3 Contractor Responsibilities:

.1 Construction and Acceptance Phase:

.1 Facilitate coordination of commissioning work by CxA and integrate commissioning activities into the master schedule.

.2 Attend commissioning scoping meeting and additional meetings, as necessary.

.3 Furnish copies of construction documents, addenda, change orders, RFI, submittals and shop drawings related to commissioned equipment and systems to CxA.

.4 Ensure Subcontractors execute their commissioning responsibilities according to the contract documents, specifications and Commissioning Plan.

.5 Submit training agenda and plan to CxA prior to training and coordinate training with the City's installing contractors.

.6 Work with Subcontractors to prepare O&M manuals, according to specifications, including updating original sequences of operation and plans to Record conditions.

.7 Provide all documentation requested by the commissioning authority relating to the preparation of the Systems Manual.

.8 Assist in resolution of system deficiencies identified during commissioning. Correlate the resolution of all deficiencies with final payment to associated contractor less warranty retention.

.4 Mechanical, Electrical, Controls and TAB Subcontractor Responsibilities:

.1 Construction and Acceptance Phase:

.1 Attend commissioning kick-off meeting, additional commissioning coordination meetings and deficiency resolution meetings, as necessary.

.2 Provide additional requested documentation, prior to normal O&M manual submittals, to CxA for development and review of start-up and functional testing procedures.

.3 Assist in clarification of operation and control of commissioned equipment as necessary for writing detailed testing procedures.

.4 Develop start-up and checkout plan for commissioned equipment based on manufacturer's recommendations and vendor's in-house checklists. Submit to CxA for review and approval prior to start-up.

.5 During startup and checkout process, execute pre-functional checklists for commissioned equipment. Perform and document completed startup and system operational checkout procedures. Be present on the job site to review pre-functional checklists results with the CxA as requested.

.6 Subcontractors to execute their commissioning responsibilities and demonstrate functional performance of up to 100% of all

Mechanical, Electrical, Plumbing, HVAC, Lighting, and BAS/EMRS systems with witnessing by the CxA.

.7 Resolve A/E punch list items before implementation of functional testing.

.8 Air and water TAB to be completed with discrepancies and problems resolved before functional testing.

.9 Perform functional testing, under direction of CxA, for commissioned equipment.

.10 Resolve equipment or system deficiencies by making hardware or software changes necessary to satisfy project plans and specifications and retest as required.

.11 Prepare O&M manuals according to specifications, including updating original sequences of operation and plans to Record conditions.

.12 Provide training of the City's operating personnel for all installed equipment and/or equipment the City requests training for.

.13 Coordinate with equipment manufacturers to determine requirements to maintain validity of warranties.

.14 Provide all necessary handheld instruments in order to perform startup, checkout, pre-functional testing, functional testing and deficiency resolution.

.15 TAB to provide test and balance plan to CxA for approval 3 weeks before balancing begins.

.16 TAB to maintain a deficiency log (including air, water & controls issues) provided to the CxA on a weekly basis.

.17 TAB to submit final test and balance data to CxA for review.

.18 Each contractor shall provide a written detailed description of all major components they provide or install that are part of the commissioned systems. The MC shall provide a description of all hydronic and air systems that are installed. The CC is required to submit a narrative description of the HVAC control system. All written system descriptions shall be submitted electronically in Microsoft Word format to the CxA accompanying prefunctional checklist submissions to the CxA.

.19 Single line diagrams of each commissioned system shall be provided by mechanical contractor or Subcontractors and submitted to CxA for approval. Diagrams shall be untangled to reflect the simplest display of ducting or piping lines possible. Equipment capacities and flow rates shall be displayed on diagram adjacent to associated equipment.

.5 Controls Subcontractor Responsibilities:

.1 Sequences of Operation Submittals: Controls submittals to include complete and detailed sequences of operation for each piece of equipment.

.2 Control Drawings Submittal shall include:

.1 Graphic schematic depictions of systems and individual components associated with the control system, including equipment primarily controlled by packaged controls. All control interfaces to embedded controls within packaged systems will be fully detailed.

.2 Full points list including for each point, system name, point abbreviation and description, point type, and display unit.

.3 Controls Subcontractor to prepare and submit to the CxA a written plan that will be followed to test, checkout and adjust control system prior to functional performance testing. Plan shall include verification of all installations of end devices, wiring between device and controller, calibration of analog inputs, point-to-point verification, and controller software configuration. Control system checkout is a component of prefunctional testing and all specifications requirements of prefunctional checklists shall apply.

.4 Controls Subcontractor to be present as necessary to manipulate control system and record results of calibration process and enter results into control system software or equipment software. Ensure Subcontractors execute their commissioning responsibilities and demonstrate functional performance of up to 100% of all Mechanical, Electrical, Plumbing, HVAC, Lighting, and BAS/EMRS systems with witnessing by the CxA.

.5 Ensure Subcontractors execute their commissioning responsibilities and demonstrate functional performance of up to 100% of all Mechanical, Electrical, Plumbing, HVAC, Lighting, and BAS/EMRS systems with witnessing by the CxA.

.6 Signed and dated certification to CxA and the City upon completion of control system checkout.

.7 Record Drawing version of control drawings and sequences of operation to be included in final controls O&M manual submittal.

.6 The City's Technical Staff Responsibilities:

.1 Design, Construction and Acceptance Phase:

.1 Provide the City's Project Requirements (OPR)

.2 Arrange for required facility operating and maintenance personnel to participate in commissioning activities and training sessions.

.3 Provide final acceptance of building contingent upon the resolution of all deficiencies identified during the commissioning process.

.7 Manufacturer's Representative and Equipment Suppliers Responsibilities:

.1 Provide requested submittal data, including detailed start-up procedures, installation and operation manuals, controls wiring diagrams and specific responsibilities of the City to keep warranties in effect.

.2 Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

.3 Assist in equipment testing and training per agreements with contractors.

.8 Information Technology

.1 The provision of resources, both equipment and human, to implement system components as defined in the detailed design requirements provided by the Designers.

1.6 COMMISSIONING PROCESS

.1 Commissioning Plan. The commissioning plan is developed by the CxA to provide guidance to the team in execution of the commissioning process.

.2 Kick-Off Meeting. Members of design and construction team involved in the commissioning process meet and discuss scope of work, tasks, schedules, deliverables, and responsibilities for implementation of Commissioning Plan.

.3 Submittals. The Contractor submits commissioning documents to the CxA during regular submittals. The commissioning documents to be submitted as part of regular submittals include manufacturer's installation instructions, startup and test procedures, operation and maintenance instructions, performance data and control drawings.

.4 Installation and Startup. The subcontractors, under their own direction, execute and document equipment installation and startup using the pre-functional checklists and perform startup and initial checkout. Completed checklists are provided to the CxA as documentation of the commissioning progress. In some cases, the CxA may elect to witness the completion of installation and startup procedures.

.5 Functional Performance Tests. The functional test procedures will be developed by the CxA. Functional testing will not begin until all startup/prefunctional tests have been received and accepted by the CxA and the City. The functional performance tests will be executed by the contractor owning the work. The CxA will direct and witness the tests and collect documentation confirming that the tests were completed. Deferred testing is conducted, as specified or required.

.6 Monitoring-Based Commissioning. The MBCx procedures will be developed by the CxA and documented in the Commissioning Plan. The Controls Subcontractor will setup all required points, trend logs, graphs, reports and other items as may be required to support the MBCx effort. Issues will be logged in the issues log and will be reviewed by the City, Contractor and subcontractors, and CxA.

.7 Deficiencies and Non-conformance. Commissioned systems which fail to meet the requirements of Installation, Startup or Functional Performance Tests will be corrected at the subcontractor's expense and the system will be retested. An ongoing Issues Log, maintained by the CxA, will be provided to the City and Contract Administrator.

.8 O&M Manuals. The CxA will review the O&M documentation for completeness.

.9 O&M Training. The sub-consultants will provide the CxA with an outline of items to be covered during O&M Training. The CxA will approve the training program and verify it has been completed.

.10 Systems Manual. The CxA will prepare and deliver the Systems Manual.

.11 Commissioning Report. The CxA compiles final commissioning report which summarizes tasks, findings, and documentation of commissioning process. The report addresses actual performance of building systems in reference to design intent and contract documents and includes an executive summary of the process and results of the commissioning program, including observations, conclusions and any outstanding items, a history of any system deficiencies identified and how they were resolved, including any outstanding issues or seasonal testing scheduled for a later date and systems performance test results and evaluation. Also included is a summary of the design and

submittal review process and a summary of the O&M documentation and training process.

.12 Post-Occupancy Review. The CxA conducts a review of the building operations within 10 months after substantial completion with the O&M staff and occupants.

1.7 SYSTEMS TO BE COMMISSIONED

The following new systems will be commissioned as part of this project.

.1 HVAC Equipment and Control Systems:

- .1 Air Cooled Chillers
- .2 Boilers
- .3 Pumps (chilled water, hot water)
- .4 Air Handling Units
- .5 Ventilation Air Handling Units
- .6 Heating Coils
- .7 Exhaust and Supply Fans (garage, toilet, and general exhaust)
- .8 Stair Pressurization Fans
- .9 Air Terminal Units (amenity spaces)
- .10 Packaged DX Equipment (telco and elevator machine rooms)
- .11 Fan Coil Units (amenity spaces)
- .12 Building Management and Control System (BMCS)

.2 Plumbing Equipment and Control Systems:

- .1 Domestic Water Pumps
- .2 Water Heaters
- .3 PRVs
- .4 Water Meters
- .5 Plumbing Fixtures
- .6 Fuel Systems (natural gas)

.3 Fire Sprinkler Equipment and Control Systems:

- .1 Fire Pump(s) and Controller
- .2 Jockey Pump(s) and Controller
- .3 PRVs
- .4 Dry-Pipe/Pre-Action Systems

.4 Electrical Equipment and Control Systems:

- .1 Life Safety Generator
- .2 Automatic Transfer Switches
- .3 Switchboards
- .4 Metering
- .5 Lighting Control

.6 Fire Detection, Alarm and Communications System

.7 Grounding

.8 Surge Suppression

.9 Heat Tracing

2 Products

2.1 TEST EQUIPMENT

.1 The Contractor and Subcontractors shall provide all equipment required to conduct the tests specified. The Contractor shall advise the commissioning team of instrumentation to be used and the dates the instruments were calibrated.

.2 All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

3 Execution

3.1 MEETINGS

.1 Commissioning Kick-off. The CxA will conduct a Commissioning Kick-off Meeting to ensure that the roles and responsibilities are understood by all commissioning team members.

.2 Commissioning Progress. The CxA will facilitate commissioning progress meetings as necessary to review commissioning progress and to identify any outstanding issues to the commissioning team.

3.2 SUBMITTALS

.1 The Contractor will provide commissioning submittals to the CxA for systems to be commissioned as defined in Part 1, Section 1.7, Systems to be Commissioned. Systems that are not within the commissioning scope do not require commissioning submittals. Commissioning submittals must include equipment manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures and control drawings. The submittals should also include the installation and checkout materials that are actually shipped with the equipment and the actual field checkout sheet forms to be used by the factory or field technicians.

.2 The Contractor will provide all documentation requested by the CxA relating to the preparation of the Systems Manual.

.3 After the Submittal is approved by the designer the CxA will request additional information from design team, contractors and Subcontractors such as O & M and installation literature or other technical data in order to facilitate the commissioning process.

.4 CxA may request additional design and operations narrative from Subcontractors and A/E.

3.3 STARTUP, PRE-FUNCTIONAL INSPECTION CHECKLISTS

.1 Prefunctional checklists are important to ensure .that the equipment and systems are properly installed and operational and to ensure that functional testing may proceed without unnecessary delays. Each piece of equipment receives full prefunctional

checkout by the responsible contractor. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

.2 Development. The Contractor will develop prefunctional checklists and startup plan during submittal reviews. All vendor information must be submitted to the CxA for review at least four weeks prior to arrival of the equipment on site. The checklists should include, at minimum, all manufacturer or vendor Installation and Startup instructions. The CxA will review and approve the procedures in the prefunctional and startup checklists. The CxA will also note any procedures that must be added to the checklists.

.3 Pre-functional checklists: Pre-functional checklists shall verify all aspects of equipment including but not limited to equipment manufacturer, model, capacity, efficiency, accuracy, status, full modulation capability, type, ratings, accessories, compatibility, installation methods and other project specification requirements.

.4 Completion. The Contractor or appropriate subcontractor designated by the GC will complete prefunctional checklists and startup procedures for equipment to be commissioned, as defined in Part 1, Section 1.7, Systems to be Commissioned. Contractors will schedule pre-functional testing activities and inform CxA of the schedule to enable the CxA to attend if desired. Prefunctional and Startup checks must be completed by the GC or subcontractor and approved by the CxA prior to commencing Functional Performance Testing. GC completes all pre-functional tests in their entirety and submits completed pre-functional test reports to the CxA for review. Subcontractors and vendors execute startup and checkout and provide CxA with signed and dated copy of completed startup reports. The CxA will witness some, but not all equipment start-up.

3.4 FUNCTIONAL PERFORMANCE TESTING

.1 Before Functional Performance Testing procedures are executed the GC must have submitted all commissioning submittals to the CxA and completed Pre-functional and Startup Checklists and TAB is completed for the given system being commissioned. Controls system and equipment it controls are not functionally tested until points have been calibrated and pre-functional checklists are completed. Lighting control system or lighting control component prefunctional checklists must be complete before functional testing is scheduled for lighting controls.

.2 Objectives and Scope. Demonstrate each system is operating according to documented design intent, construction documents, and/or bidder design package. Functional testing verifies components, equipment, systems, and interfaces between systems operate correctly and include operating modes, interlocks, control sequences, and responses to emergency/life safety conditions. Verification procedures are reviewed, witnessed, and documented by the CxA.

.3 Forms. The CxA will develop functional test procedures and forms based on project plans and specifications, contractor approved submittals and contractor submitted installation, operation & maintenance manuals for each piece of equipment being commissioned. IO&M manuals will be required to be submitted to the CxA during pre-functional test development. The GC or appropriate subcontractor will review the tests for feasibility, safety, equipment and warranty protection prior to execution.

.4 Development of Forms. Test procedure forms, developed by the CxA, to include the following information:

.1 System and equipment or component name(s).

.2 Equipment location and ID number.

.3 Date.

.4 Participating parties.

.5 Instructions for setting up test, including special cautions and limits.

.6 Specific procedures to execute test.

.7 Acceptance criteria of proper performance with date passed and initials boxes.

.8 Section for comments or notes.

.9 Approval of Forms. The CxA may submit to the City or Contract Administrator the test forms for review.

.10 Test Methods. Functional Performance Testing, depending on equipment, may be achieved by direct manipulation of system inputs such as temperature sensors, setpoints, or short-term monitoring of parameters using stand-alone data loggers or DDC controls system (trend logging). A combination of methods may be required to test complete sequence of operations. The testing method to be used will be specified on the forms developed by the CxA.

.11 Schedule. The GC or subcontractor shall keep the CxA informed of progress with pre-functional checklists and startup of equipment and systems. Functional testing will not be scheduled until all control system start-up and checkout plans, TAB reports and prefunctional checklists have been completed and submitted to the CxA for review and approval. The CxA will schedule the Functional Performance Testing through the City, GC and appropriate subcontractors.

.12 Dry Run Tests. CxA will provide the subcontractor Functional Test forms for dry run testing by the subcontractor. The subcontractor will execute all functional tests in advance of formal functional testing with the CxA, the City and construction team. In addition the subcontractor will review their associated approved submittal to ensure that the installed system meets the requirements of the approved submittal prior to functional testing.

.13 Test Completion. The subcontractor responsible for installing the equipment will perform the Functional Performance Tests. Each test procedure is performed under conditions that simulate normal building operating conditions as closely as possible. The subcontractor performing the tests shall provide all necessary materials and system modifications to measure performance and produce testing conditions described on the forms. The CxA will witness and document the tests. If damage to equipment or system results from the implementation of a functional performance test that was sent to the subcontractors for review, it is the subcontractor's responsibility to provide all equipment and labor necessary to make repairs.

.14 Sampling. The CxA, at their discretion, may use a quality based sampling strategy to verify Functional Performance Testing for multiple identical pieces of equipment. When sampling is used, the CxA will witness and document Functional Performance Testing for a representative cross section of identical equipment.

.15 Problem Solving. The CxA may recommend solutions to problems or deficiencies found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subcontractors and A/E.

.16 Deferred Testing. Deferred testing may be required due to seasonal variation in operations of equipment or due to inappropriate occupancy condition. Control strategies may require additional testing during opposite season to verify performance of HVAC system and controls.

3.5 MONITORING-BASED COMMISSIONING

.1 The CxA will develop MBCx procedures and document them in the Commissioning Plan.

.2 The subcontractors will install and calibrate all metering and sensor devices according to the manufacturer's instructions. Defective devices will be recalibrated or replaced.

.3 The Controls Subcontractor will setup all required BAS points, trend logs, graphs, reports and other items as may be required to support the MBCx effort.

.4 For a period of one year after occupancy, the City or Contract Administrator will review building operation and trend logs (typically monthly) to confirm proper operation of the building systems. Any need for re-training of the City's staff or operations team will also be identified.

.5 Deficiencies will be documented in the issues log and will be corrected by the responsible subcontractor at no additional cost to the City. The issues log will be reviewed by the City, Contractor and subcontractors, and CxA.

3.6 DOCUMENTATION, ISSUES LOG, AND APPROVAL OF TESTS

.1 Documentation. The CxA will witness and document the results of Functional Performance Testing using the forms developed for that purpose. The completed forms will be included in the Final Commissioning Report and the O&M Manuals.

.2 Non-Conformance. Minor deficiencies identified during Functional Performance Testing may be corrected immediately and retested with resolution documented on procedure form. Larger deficiencies which cannot be resolved on-site will be rescheduled for testing at a later date. In all cases the CxA will make note of non-compliance and corrections made on the forms.

.3 Issues Log. Deficiencies identified during Functional Performance Tests that cannot be corrected during the testing will be documented by the CxA in the Issues Log. The Issues Log shall include details of components or systems found to be non-compliant with parameters of test plans or project documents and attempts to identify responsible party. The log will be provided to all commissioning team members.

.4 Cost of Retesting. Cost to conduct retesting will be covered by the subcontractor, unless the deficiencies are due to manufacturer defect.

.5 The cost to retest a prefunctional or functional test beyond 10% of the total number of tests will be back-charged to the responsible subcontractor.

.6 For a deficiency identified, not related to any prefunctional checklist or start-up fault, the following shall apply: The CxA and PM will direct the retesting of the equipment once at no "charge" to the GC for their time. However, the CxA's time for a second retest will be charged to the GC, who may choose to recover costs from the responsible Sub.

.7 The time for the CxA to execute any re-testing required because a specific prefunctional checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be back-charged to the GC, who may choose to recover costs from the party responsible for executing the faulty prefunctional test.

.8 Approval. The CxA will document each completed Functional Performance Test on the forms.

.9 Where Functional Performance Tests indicate systems are functioning normally, the CxA will formally provide approval of Functional Performance Tests after review.

.10 CxA recommends acceptance of each test to the City or the City's Project Manager.

.11 The City gives final approval on each test.

.12 CxA and the City's final approval of all tests and resolution of all deficiencies is necessary before the City will accept the building and turnover of the building to the City can take place. Final payment to GC and all contractors may be withheld by the City subject to the prerequisite of final acceptance of the building by the City.

3.7 OPERATIONS AND MAINTENANCE MANUALS

.1 Contents. The O&M Manual will be provided by the GC and will include the following items, at a minimum:

.1 A narrative describing the system, including:

.2 Startup, normal operations, shutdown, unoccupied operation, seasonal changeover and manual operation;

.3 Contact information of equipment manufacturer or vendor;

.4 Control drawings and schematics;

.5 Installation, operating and maintenance instructions;

.6 Maintenance schedules;

.7 Parts list, including suppliers for parts;

.8 List of special tools required for maintenance;

.9 Performance and warranty data;

.10 Troubleshooting & alarms.

.11 Format. The O&M Manual must be provided in a format which will allow for efficient and easy access. An electronic copy shall be provided in a widely supported format. If a physical copy is provided, the O&M Manual must be bound in labeled binders and be divided with tabs.

.12 The specific content and format requirements for the standard O&M manuals are detailed in the specifications.

.13 Review and Approval. Prior to substantial completion the subcontractors submit to the CxA for review the O&M manuals, documentation and redline as-builts for systems that were commissioned to verify compliance with the specifications and project requirements. The CxA will communicate deficiencies in the manuals to the PM or A/E, as requested. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. Upon successful review of the manuals, the CxA will recommend approval and acceptance of the O&M Manuals to the Design Team. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

3.8 SYSTEMS MANUALS

.1 Contents. The Systems Manual will be developed and prepared by the CxA with the assistance of the Contractor, and will include the following items, at a minimum:

.1 Final version of the City's project requirements

.2 Basis of design

.3 As-built sequences of operations

.4 Time-of-day schedules and schedule frequency

.5 Detailed point listings with ranges and initial set points

.6 Operating instructions for integrated building systems

.7 Seasonal operational guidelines

.8 Recommendations for recalibration frequency of sensors and actuators

.9 Subcontractor provided Single line diagrams of each commissioned system

.10 Troubleshooting table for ongoing achievement of the City's project requirements

.11 Blank functional test forms

3.9 OPERATIONS AND MAINTENANCE TRAINING

.1 Content. The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed. Each subcontractor and/or vendor responsible for training will submit a written training plan to the CxA for review and approval prior to training. The training plan should cover the following elements:

.1 Equipment (included in training)

.2 Intended audience

.3 Location of training

.4 Objectives

.5 Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)

.6 Subjects covered (description, duration of discussion, special methods, etc.)

.7 Duration of training on each subject

.8 Instructor for each subject

.9 Approval. The CxA will document that the training was completed according to the contract documents.

.2 Re-Training. The MBCx effort may identify the need for re-training. The responsible subcontractor and/or vendor will provide re-training at no additional cost to the City.

END OF SECTION

1 General

1.1 SUMMARY

.1 Work Includes:

.1 Provision and installation of materials and equipment necessary to remediate the Project Site.

.2 Implementation of safety work zones, Site Specific Health and Safety Plans and Environmental Protection Plan.

.3 Protection of utilities, structures, and other areas of concern.

.4 Management of contaminated soil generated during soil remediation Work, including storing, loading, hauling, and removal, as necessary.

.5 Management of contaminated waters generated during soil remediation Work, including separation, recovery, and elimination of free-phase hydrocarbons, plus recovery of sediment-laden storm water runoff.

.6 Backfilling of excavations.

.7 Obtaining required permits and approvals for waste disposal.

1.2 REFERENCES

.1 Applicable environmental and health and safety Laws and Regulations for Province of Manitoba and Municipal By-Laws.

.2 CCME (Canadian Council of Ministers of the Environment) and applicable publications.

.3 Manitoba Environment and Climate Change.

.4 National Fire Code 2020.

.5 National Building Code 2020.

1.3 ENVIRONMENTAL PROCEDURES

.1 Section 01 35 43 - Environmental Procedures.

1.4 SUBMITTALS

.1 Provide submittals in accordance with 01 33 00 - Submittal Procedures.

.2 Closeout Submittals:

.1 Provide Closeout Submittals in accordance with Section 01 78 00 as follows:

.1 Provide documentation of tonnage of petroleum hydrocarbon impacted soil that has been excavated from the former gas station remediations in AEC 3 and AEC 4 and transported to the landfill.

.2 Provide documentation of volume of both impacted and non impacted soil that has been excavated from the Site.

.3 Provide documentation of volume of waste/debris that has been excavated from within the Former Brooklands Landfill footprint and transported to the landfill.

.4 Provide documentation of volume of clean backfill loaded, transported, placed and compacted at the Site, if required.

.5 If imported fill is required, the Contractor shall provide the Contractor Administrator with the location of the backfill source and the Contract Administrator will collect samples. Any backfill source will require at least two samples be provided for analysis, one sample for every 500 m^3 for the first 2,000

m^3, one sample for each 1,000 m^3 thereafter and after 40,000 m^3, one per 2,000 m^3.

.6 Provide documentation of required labour, equipment usage, fuel and/or power usage, environmental monitoring and inspection records, as required.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Identify key members of project team including Project Manager and Site Supervisor. Define experience and qualifications of each key team members.

.2 Field Samples:

.1 Impacted soil and confirmatory samples will be collected on behalf of the Contract Administrator for potential laboratory analyses, with assistance by the Contractor, as requested by the Contract Administrator.

.3 Survey:

.1 The Contract Administrator will coordinate surveys in collaboration with the Contractor as required.

.4 Kick-off meeting:

.1 The Contractor shall organize a Pre-Excavation Conference for soil remediation one (1) week prior to excavation works, equipment/machine operators, third party/subcontractor representative, and Contract Administrator to review the following:

.1 General project requirements.

.2 Contractor's Quality Control Plan for the soil remediation.

.3 Contractor's procedures prior, during and following soil excavation.

.4 Also provide agenda and meeting minutes, distribute the agenda to the attendee four (4) days prior to the Pre-Excavation Conference. Distribute Pre-Excavation Conference minutes within four (4) days of the meeting.

1.6 SITE CONDITIONS

.1 The approximate locations of known services or utilities and buried objects are as indicated on the Drawings however it is the responsibility of the Contractor to establish location (horizontal position and depth) and extent of utility service lines in work areas before starting Work.

.2 Suspend operations whenever climatic conditions are unsatisfactory for excavation to conform with this Specification. Backfill to be completed in accordance with CW 2030.

.3 After occurrence of heavy rains, do not operate equipment in designated areas until the material has dried sufficiently to prevent excessive rutting.

1.7 PROTECTION

.1 Prevent damage to fencing, trees, landscaping, natural features, benchmarks, property pins, existing buildings, existing pavement, utility lines and Project Site appurtenances, which are to remain. Correct any damage caused by construction operations.

.2 Provide protection to utilities, structures and other areas of concern with the implementation of shoring or support, in areas shown on Specification Drawings.

.1 Contractor shall be responsible for design, installation, maintenance, and removal of all temporary shoring or supports.

.2 Provide physical barrier to prevent accidental equipment collision to existing groundwater or vapour monitoring wells outside of excavation areas. Physical barrier shall be able to resist impact from equipment working in proximity to groundwater monitoring wells.

.3 Provide temporary fencing and gates as required to surround all excavations and work areas necessary at the Project Site to secure the work areas and protect the public.

.4 Environmental protection measures shall be in accordance with the requirements specified in Section 01 35 43.

.5 The release of all contact accumulated water, contact water, groundwater, landfill leachate and rinse water shall conform to the requirements outlined in Section 01 35 43.

1.8 PERSONNEL PROTECTION

.1 Areas designated for cleanup under this Section involve soils or groundwater containing petroleum hydrocarbon products, metals, waste and which may be dangerous to human health and/or the environment.

.2 When working with contaminated media, workers shall wear the required personal protective clothing and equipment that is acceptable for the Work.

.3 Supply sufficient quantities of designated protective equipment to fit all site personnel including authorized visitors. Educate workers as to construction risks and train on safe work practices.

.4 No separate pay item shall apply to the work practice requirements, including personnel protection, of this Section. Costs shall be included in the applicable payment items to which this Section applies.

1.9 SIGNS

.1 Signage: Provide and erect signage at access points to the Project Site as required. Signage shall be visible from all sides of these areas. The English version of the sign shall read:

CAUTION: CONTAMINATED SOIL EXCAVATION AREA

AUTHORIZED PERSONNEL ONLY

.2 Signage shall indicate all required personal protective equipment to enter the area.

.3 Post a similar sign in any other language of that is applicable.

.4 All lettering shall be black, not less than 100 mm high, with a 25 mm wide stroke, on a light--coloured background.

1.10 TESTING

.1 Assist Contract Administrator in collection of confirmatory soil samples from petroleum hydrocarbon excavations (AEC 3 and AEC 4) for field screening at 1.0 m depth intervals or at obvious stratigraphic boundaries along the excavation margins on a 5 m by 5 m grid, or as directed by the Contract Administrator. Confirmatory soil samples will be selected for laboratory analysis by the Contract Administrator.

.2 The Contractor shall provide access to the Contract Administrator to collect confirmatory samples in all excavation areas of the Site. Soil samples will be selected for laboratory analysis by the Contract Administrator.

1.11 MEASUREMENT FOR PAYMENT

.1 Measurement and Payment in accordance with CW 2030.

2 Products

2.1 MATERIALS

.1 Backfill in accordance with CW 2030 and reference Section 6.2.3.3 of the Remedial Plan (Appendix 1) for placement of metals impacted soil as backfill in the petroleum hydrocarbon remediations, within the onsite berm or offsite to an approved facility that accepts contaminated soil.

.2 Place metals impacted soil as identified by the Contract Administrator in the containment berm as referenced in Section 6.2.5 of the Remedial Plan (Appendix 1).

.3 If a PHC resistant liner is required along the northern property boundary of the Site (AEC 3 or AEC 4), the liner specifications shall be reviewed and approved by the Contract Administrator prior to use.

3 Execution

3.1 APPLICATION

.1 Soil Management:

.1 Do not dilute contaminated soil with less contaminated soil.

.2 Water Management:

.1 Any groundwater, storm water or precipitation accumulated within excavations encountered during remedial work at the Project Site requires analytical testing and, if required, treatment and disposal.

.2 Contractor to collect required water samples for laboratory analysis and obtain necessary approvals from the City of Winnipeg for sanitary or storm discharges.

.3 Treat groundwater, storm water and precipitation which contains contaminants in excess of acceptable wastewater disposal guidelines.

.4 Store, transport, and eliminate off site or treat residues generated by water treatment process in accordance with standards, requirements and regulations of Manitoba Environment and Climate Change.

3.2 SITE EXCAVATION

.1 Provide for access to the site to facilitate entrance and exit of equipment and trucks from the area during operation.

.2 Repair and maintain the access road, as required, prior to use.

.3 Segregate and separate debris and clean of impacted soil as required for appropriate disposal at an approved landfill.

.4 It is assumed waste and soil excavated from within the landfill footprint is impacted and will be disposed at an approved facility.

.5 Segregate the metals impacted soil and petroleum hydrocarbon impacted soil in distinct locations for offsite disposal. A portion of the metals impacted soil will be contained onsite and all PHC impacted soil will be disposed of off-site as outlined in Section 6.2.3.4 of the Remedial Plan (Appendix 1).

.6 Delineate the various remediation boundaries of the Site as identified by the Contract Administrator.

.7 Provide and erect signage at access points to the site as required.

.8 Initial excavation limits will be identified by the Contract Administrator, generally as described in City of Winnipeg North Transit Garage Replacement Design Remedial Plan, February 2025.

.9 Excavation, disposal, and backfill procedure as described in Appendix 1.

END OF SECTION

1 General

1.1 SUMMARY

1. Products installed but not supplied under this section:
    1. Fabricated components
    2. Anchor bolts
    3. Bearing plates
    4. Sleeves
    5. Other inserts to be cast in or embedded into concrete

1.2 RELATED REQUIREMENTS

1. Section 03 20 00 – Concrete Reinforcing
2. Section 03 30 00 – Cast-in-Place Concrete
3. Section 05 50 00 – Metal Fabrications
4. Section 05 51 00 – Metal Stairs and Ladders

1.3 ABBREVIATIONS AND ACRONYMS

1. HDO: High density overlay plywood
2. MDO: Medium density overlay plywood

1.4 REFERENCE STANDARDS

1. CSA Group (CSA):
    1. CSA A23.1/A23.2:19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
    2. CSA O86:19, Engineering design in wood
    3. CSA O121-17, Douglas fir plywood
    4. CSA O151-17, Canadian softwood plywood
    5. CSA O153-13, Poplar plywood
    6. CSA O325-16, Construction sheathing
    7. CSA O437.0-93, OSB and Waferboard
    8. CSA S269.1-16, Falsework and formwork
2. ULC Standards (ULC):
    1. CAN/ULC-S701.1:20, Standard for Thermal Insulation, Polystyrene Boards

1.5 ADMINISTRATIVE REQUIREMENTS

1. Coordinate with:
    1. Section 03 20 00 – Concrete Reinforcing.
    2. Section 03 30 00 – Cast-in-Place Concrete.
    3. Section 05 50 00 – Metal Fabrications, 05 51 00 – Metal Stairs and Ladders, for items embedded or cast into concrete.
2. Pre-Installation Meetings: Conduct a site meeting in accordance with Section 01 31 19 – Project Meetings, attended by Contract Administrator, manufacturer's services representative, specialty Subcontractors for forming and finishing, and related Subcontractors to:
    1. Verify project requirements.

2. Review delivery, storage, and handling requirements.
3. Review installation and substrate conditions.
4. Coordinate with other Subcontractors.
5. Review manufacturer’s instructions and warranty requirements.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

1. Submit in accordance with Section 01 33 00 – Submittal Procedures.
2. Product Data:
    1. Submit manufacturer's instructions, product literature, and data sheets for proprietary materials used in formwork liners, water stops, and coatings, including product characteristics, performance criteria, physical sizes, finishes, and limitations.
    2. Submit WHMIS Safety Data Sheet (SDS).
3. Submit shop drawings for formwork and falsework.
    1. Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba, Canada.
    2. Prepare shop drawings in accordance with CSA S269.1 for formwork and falsework.
    3. Indicate formwork design data, permissible rate of concrete placement, and temperature of concrete in formwork.
    4. Indicate sequence of erection and removal of formwork and falsework.
    5. Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts.

1.7 QUALITY ASSURANCE

1. Perform in accordance with Section 01 43 00 – Quality Assurance.
2. Retain a professional engineer registered or licensed in the Province of Manitoba, Canada with experience in formwork and falsework design of comparable complexity and scope to this Project to perform the following services as part of work of this section:
    1. Design of formwork and falsework.
    2. Review, stamp, and sign fabrication and erection shop drawings, design calculations and amendments.
    3. Conduct on-site inspections. Prepare and submit inspection reports verifying this part of work is in accordance with Contract Documents and reviewed Shop Drawings.

1.8 DELIVERY, STORAGE, AND HANDLING

1. Deliver, store, and handle materials in accordance with Section 01 61 00 – Common Product Requirements, and:
    1. Maintain formwork liners for architectural concrete without defects or damages that could affect concrete appearance or cause staining.
2. Packaging Waste Management: In accordance with Section 01 74 19 – LEED Construction Waste Management.

2 PRODUCTS

2.1 MATERIALS

1. Formwork Materials:
    1. For concrete without special architectural features, use wood and wood product formwork materials to CSA O86.
    2. For concrete with special architectural features, use formwork materials to CSA A23.1/A23.2.
    3. Rigid insulation board: To CAN/ULC-S701.1.
2. Pan Forms: removable steel free of bends, dents, and residual concrete with a high potential for reuse.
3. Tubular Column Forms: Round, spirally wound, polyethylene impregnated virgin kraft interior layer and a waxed exterior, internally treated with release material.
    1. Spiral pattern not to show in hardened concrete.
4. Form Ties:
    1. For concrete not designated 'Architectural': Removable or snap-off metal ties, fixed or adjustable length, and free of devices leaving holes larger than 25 mm in diameter in concrete surface.
5. Form Liner:
    1. Plywood: Douglas Fir to CSA O121.
6. Form Release Agent: Proprietary, non-volatile material that will not stain concrete or hinder the application of subsequent coatings, treatments, or flooring materials to the concrete surface. non-petroleum containing non-toxic.
7. Falsework Materials: To CSA S269.1.
8. Sealant: To Section 07 92 00 – Joint Sealants.

3 EXECUTION

3.1 PREPARATION

1. Before placing concrete, clean formwork in accordance with CSA A23.1/A23.2.

3.2 FABRICATION AND ERECTION

1. Verify lines, levels, and centres before proceeding with formwork/falsework. Confirm that dimensions match the Drawings.
2. Obtain Contract Administrator's acceptance for use of earth forms framing openings not indicated on Drawings.
3. Hand trim sides and bottoms and remove loose soil from earth forms before placing concrete.
4. Fabricate and erect falsework in accordance with CSA S269.1.
5. Do not place shores and mud sills on frozen ground.
6. Provide site drainage to prevent washout of soil supporting mud sills and shores.
7. Fabricate and erect formwork in accordance with CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2.
8. Align form joints and make watertight.
    1. Minimize the number of form joints used.

9. Use 25mm chamfer strips on external corners and 25mm fillets at interior corners and joints, unless otherwise indicated on Drawings.
10. Form chases, slots, openings, drips, recesses, and expansion and control joints as indicated.
11. Refer to architectural Drawings for concrete members requiring architectural exposed finishes.
12. Build in anchors, sleeves, and other inserts required to accommodate work specified in other sections.
    1. Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
13. Line forms for the following surfaces:
    1. Outer face of outside beams.
    2. Soffit of girders and underside of bridge decks if exposed.
    3. Exposed faces of abutments, wingwalls, piers and pylons. Do not stagger joints of form lining material. Align joints to obtain uniform pattern.
14. Lining forms installation process:
    1. Secure lining taut to formwork to prevent folds.
    2. Pull down lining over edges of formwork panels.
    3. Ensure lining is new and not reused material.
    4. Ensure lining is dry and free of oil when concrete is poured.
    5. Application of form release agents on formwork surface is prohibited where drainage lining is used.
    6. If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.
    7. Cost of textile lining is included in price of concrete for corresponding portion of work.

3.3 REMOVAL AND RESHORING

1. Leave formwork in place after placing concrete for a minimum:
    1. 2 days for walls, sides of beams, columns, footings and abutments.
    2. 5 days for beam soffits, slabs, decks and other structural members, or 3 days when replaced immediately with adequate shoring to standard specified for falsework.
2. Remove formwork when concrete has reached 70% of its 28-day design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.
3. Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
4. Space reshoring in each principal direction at not more than 3000 mm apart.
5. Reuse formwork and falsework subject to requirements of CSA A23.1/A23.2.

3.4 SITE QUALITY CONTROL

1. Site Inspections:
    1. Professional engineer responsible for signing and stamping shop drawings to conduct on-site inspections and prepare and submit inspection reports verifying this part of the work is in accordance with Contract Documents and reviewed shop drawings.
    2. Perform inspections a minimum of one per month.

3.5 CLEANING

1. Clean in accordance with Section 01 74 00 – Cleaning.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

1. Section 03-10-00 – Concrete Forming and Accessories
2. Section 03 30 00 – Cast-in-Place Concrete

1.2 REFERENCE STANDARDS

1. American Concrete Institute (ACI):
    1. MNL-66 20, ACI Detailing Manual
2. ASTM International (ASTM):
    1. ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
    2. ASTM A143/A143M-07, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
    3. ASTM A641/A641M-19, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
    4. ASTM A767/A767M-19, Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
    5. ASTM A775/A775M-19, Standard Specification for Epoxy-Coated Steel Reinforcing Bars
    6. ASTM A884/A884M-19e1, Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
    7. ASTM A1064/A1064M-18a, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
3. CSA Group (CSA):
    1. CSA A23.1:19/CSA A23.2:19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
    2. CSA A283:19, Qualification Code for Concrete Testing Laboratories
    3. CSA A23.3:19, Design of Concrete Structures
    4. CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement
    5. CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
    6. CSA W186:21, Welding of Reinforcing Bars in Reinforced Concrete Construction
4. Reinforcing Steel Institute of Canada (RSIC):
    1. RSIC-2020, Manual of Standard Practice

1.3 ADMINISTRATIVE REQUIREMENTS

1. Coordination:
    1. Coordinate with Section 03 30 00 – Cast-in-Place Concrete

2. Pre-Installation Meetings: In accordance with Section 01 31 19 – Project Meetings, hold pre-concrete pouring meeting one week before pouring concrete.
    1. Ensure key personnel, site supervisor, specialty contractor-finishing, forming, concrete producer, testing laboratory representative attend.
        1. Verify project requirements.
        2. Review reinforcing testing report.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1. Submit in accordance with Section 01 33 00 – Submittal Procedures.
2. Product Data:
    1. Submit manufacturer's instructions if available, product literature and data sheets for proprietary materials used in concrete reinforcement. Include product characteristics, performance criteria, physical sizes, finishes, and limitations.
    2. When a chromate solution is used as a replacement for galvanizing non-prestressed reinforcement, submit a product description for review by Contract Administrator before its use.
    3. Submit WHMIS Safety Data Sheet (SDS).
3. Shop Drawings:
    1. Submit shop drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
        1. Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.
        2. Indicate placing of reinforcement and:
            .1 Bar bending details.
            .2 Quantities of reinforcement.

Sizes, spacing, locations of reinforcement and mechanical splices if approved by Contract Administrator with identifying code marks to permit correct placement without reference to structural drawings.

        3. Detail lap lengths and bar development lengths to CSA A23.3, unless otherwise indicated on Drawings.
        4. Provide Type B tension lap splices unless otherwise indicated on Drawings.
        5. Indicate position and size of openings in slabs and walls. Coordinate with the different trades requiring openings.
        6. Indicate the concrete cover dimension to the reinforcement.
4. Test and Evaluation Reports:
    1. Submit certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks before beginning reinforcing work.
5. Source Quality Control Submittals:
    1. When requested, submit, in writing, proposed source of reinforcement material.

1.5 QUALITY ASSURANCE

1. Qualifications:
    1. Testing Laboratory: Certified to CSA A283.

1.6 DELIVERY, STORAGE, AND HANDLING

1. Perform in accordance with Section 01 61 00 – Common Product Requirements.
2. Package bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
3. Storage and Handling Requirements:
    1. Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

2 Products

2.1 MATERIALS

1. Substitute different sized bars only if permitted in writing by Contract Administrator.
2. Reinforcing Steel: Billet steel, grade 400W, deformed bars to CSA G30.18, unless otherwise indicated.
3. Reinforcing steel: Weldable low alloy steel deformed bars to CSA G30.18.
4. Cold-drawn annealed steel wire ties: To ASTM A1064/A1064M.
5. Deformed steel wire for concrete reinforcement: To ASTM A1064/A1064M.
6. Welded steel wire fabric:
    1. Deformed in accordance with ASTM A1064/A1064M, fabricated from steel wire into flat sheets; sizes as indicated on Drawings.
7. Galvanizing of non-prestressed reinforcement: To ASTM A123/A123M coating Grade 85, minimum zinc coating 610 g/m^2.
    1. Protect galvanized reinforcing steel with chromate treatment to prevent reaction with Portland cement paste.
    2. If chromate treatment is carried out immediately after galvanizing, soak steel in aqueous solution containing minimum 0.2% by weight sodium dichromate or 0.2% chromic acid.
        1. Maintain temperature of solution at a minimum of 32°C and immerse galvanized steels for a minimum of 20 seconds.
    3. If galvanizing steel at ambient temperature, add a 0.5% to 1% concentration of sulphuric acid as a bonding agent.
        1. There are no temperature requirements for the aqueous solution.
    4. Chromate solution of equal effectiveness manufactured for this purpose may replace aqueous solution.
        1. Submit product description as described in ACTION AND INFORMATIONAL SUBMITTALS in Part 1 of this Section.
8. Chairs, bolsters, bar supports, spacers: To CSA A23.1/A23.2.
9. Tie wire: 1.5 mm diameter annealed wire.
10. Mechanical splices: Subject to approval from Contract Administrator.
11. Plain round bars: To CSA G40.20/G40.21.

2.2 FABRICATION

1. Fabricate reinforcing steel in accordance with CSA A23.1/A23.2, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

2. Obtain Contract Administrator's written approval for locations of reinforcement splices other than those shown on Contract Drawings and shop drawings.

3. Upon approval from Contract Administrator, weld reinforcement in accordance with CSA W186.

3 Execution

3.1 PREPARATION

1. Galvanizing to include chromate treatment.

    1. Duration of treatment: 1 hour per 25 mm of bar diameter.

2. Conduct bending tests to verify galvanized bar fragility in accordance with ASTM A143/A143M.

3.2 SITE BENDING

1. Do not bend or weld reinforcement on site except where indicated or when authorized by Contract Administrator.

    1. If site bending is authorized, bend reinforcement without heat, applying slow and steady pressure.

    2. Replace reinforcement bars that develop cracks or splits.

3.3 PLACING REINFORCEMENT

1. Cutting or puncturing vapour retarder is not permitted. Repair damage and reseal vapour retarder before placing concrete.

2. Place reinforcing steel as indicated on placing drawings and in accordance with CSA A23.1/A23.2.

3. Use plain round bars as slip dowels in concrete.

    1. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.

    2. After paint has dried, apply thick even film of mineral lubricating grease.

4. Before placing concrete, obtain Contract Administrator's approval of reinforcing material and placement.

5. Maintain minimum concrete cover to reinforcement during concrete placement.

3.4 SITE QUALITY CONTROL

1. Site tests: Conduct tests on the following and submit report as described in ACTION AND INFORMATIONAL SUBMITTALS in Part 1 of this Section:

    1. Reinforcing steel and welded wire fabric.

2. Inspection and testing of reinforcing and reinforcing materials carried out by testing laboratory designated by Contract Administrator for review to CSA A23.1/A23.2.

3. Distribute test results for discussion at pre-pouring concrete meeting between testing laboratory and Contract Administrator.

3.5 CLEANING

1. Progress Cleaning: Clean in accordance with Section 01 74 00 – Cleaning.

2. Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning.

3. Waste Management: Perform in accordance with Section 01 74 19 – LEED Construction Waste Management.

    1. Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 03 10 00 – Concrete Forming and Accessories

.2 Section 03 20 00 – Concrete Reinforcing

.3 Section 05 50 00 – Metal Fabrications

1.2 ABBREVIATIONS AND ACRONYMS

.1 Portland Cement: Hydraulic cement, blended hydraulic cement (XXb-b denotes blended) and Portland-limestone cement types:

.1 GU, GUb, GUL, and GULb: General use cement

.2 MS, MSb, and MSLb: Moderate sulphate-resistant cement

.3 MH, MHb, MHL, and MHLb: Moderate heat of hydration cement

.4 HE, HEb, HEL, and HELb: High early-strength cement

.5 LH, LHb, LHL, LHLb: Low heat of hydration cement

.6 HS, HSb, and HSLb: High sulphate-resistant cement

.2 Fly Ash Types:

.1 F: With a maximum CaO content of 8%

.2 CI: With CaO content between 15% and 20%

.3 CH: With a minimum CaO content of 20%

.3 Other Supplementary Cementitious Materials (SCM) Types:

.1 S-GGBFS: Ground, granulated blast-furnace slag

.2 N: Natural pozzolan

.3 SF: Silica fume with minimum silicon dioxide (SiO_2) content of 85%

.4 SFI: Silica fume with silicon dioxide (SiO_2) content between 75% and 85%

.5 GL: Ground glass with maximum total alkali (NaEq) content of 4%

.6 GH: Ground glass with total alkali (NaEq) content between 4% and 13%

1.3 DEFINITIONS

.1 Environmental Product Declaration (EPD): Third-party verified documentation with the supporting product category rule (PCR) and life cycle assessment (LCA) information, including at least a cradle-to-gate scope. Prepared in accordance with ISO 14025, ISO 14040, ISO 14044, and BS EN 15804 or ISO 21930.

.1 Industry average EPD, which could be referred to as an industry-wide EPD or a generic EPD, is developed by an industry association and represents the average product of multiple companies. Products covered by industry average EPD are required to follow the same PCR. Industry average EPD cannot represent a certain manufacturer or its product.

.2 Product-specific Type III EPD provides data on one product made by one manufacturer, but can involve multiple factories. Product-specific EPD can cover a product produced by a manufacturer in several plants throughout the world if all plants use the same processes. Product-specific EPD cannot represent several products and several manufacturers.

.2 SCMs: Materials added to concrete which contribute to the properties of hardened concrete through hydraulic or pozzolanic activity.

.1 Workability: This term broadly describes the total properties and expectations for concrete delivered to site as follows:

.2 Individual tested properties of concrete that account for confined or free flow slump, penetration, compaction, or relative plasticity of various concrete mix designs used for the Project.

.3 Overall properties involved with mixing, handling, transportation, and placement using vibratory compaction methods without loss of homogeneity of in-place concrete.

1.4 REFERENCE STANDARDS

.1 ASTM International (ASTM):

.1 ASTM C171-20, Standard Specification for Sheet Materials for Curing Concrete

.2 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete

.3 ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

.4 ASTM C494/C494M-17, Standard Specification for Chemical Admixtures for Concrete

.5 ASTM C881/C881M-20a, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

.6 ASTM C1017/C1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

.7 ASTM C1059/C1059M-21, Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete

.8 ASTM D412-16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension

.9 ASTM D624-00, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

.10 ASTM D1751-18, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

.11 ASTM D1752-18, Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

.2 CSA Group (CSA):

.1 CSA A23.1:19 /A23.2:19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete

.2 CSA A3000-18, Cementitious Materials Compendium

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

.1 Coordinate with Section 05 50 00 – Metal Fabrications for embedded anchors, trench drains, bollards.

.2 Coordinate with Section 07 26 00 – Vapour Retarders for sequencing and installation of underslab plastic sheet vapour retarder membranes.

.2 Pre-Installation Conference: as per Paragraph 3.1 below.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit the following action submittals minimum 4 weeks before starting work of this Section:

.1 Product data: Product literature and data sheets for proprietary materials used in cast-in-place concrete and additives, including product characteristics, performance criteria, physical sizes, finishes, WHMIS SDSs, and limitations.

.2 Source quality control submittals:

.1 Valid and recognized certificate from the plant delivering the concrete.

.2 Test data and certification by qualified independent inspection and testing laboratory, confirming materials and mix designs used in concrete mixture meet specified requirements.

.3 Site quality control submittals:

.1 Proposed quality control procedures for:

.1 Falsework erection

.2 Hot weather concrete

.3 Cold weather concrete

.4 Curing

.5 Finishes

.6 Formwork removal

.7 Joints

.8 Quality control plan: Submit written report to the Contract Administrator verifying compliance that cast-in-place concrete meets performance requirements of concrete as established in PRODUCTS in this Section.

.3 Submit the following informational submittals as work progresses:

.1 Site quality control submittals:

.1 Testing Inspection results and reports: Do not proceed without written acceptance when deviations from mix design or parameters are found.

.2 Concrete pours: Submit accurate records of poured concrete items indicating date and location of pour, quality, air temperature, and test samples taken as described in SITE QUALITY CONTROL in this Section.

.3 Concrete hauling time: Submit records of deviations exceeding the maximum allowable time of 120 minutes for concrete delivered to site of Work and discharged after batching.

.2 Submit mix design statements for each type of concrete:

.1 Mix design statements shall be sealed and signed by a Professional Engineer (Contractor’s Engineer) registered in the Province of Manitoba with minimum 5 years of experience in preparing concrete mix designs.

.2 Submit documentation a minimum of four (4) weeks prior to the first scheduled concrete casting demonstrating that the proposed mix designs and materials will achieve the required strength, durability, and performance requirements.

.3 The mix design statements shall clearly correlate to the Mix Types in Schedule A at the end of this Section.

1.7 QUALITY ASSURANCE

.1 Mock-Ups: Construct mock-ups in accordance with Section 01 40 00 – Quality Assurance.

.1 Demonstrate forming methods and materials, and procedures proposed to achieve concrete finishes in accordance with Section 03 35 00 – Concrete Finishing and clause 3.4 in this Section.

.2 Minimum sizes: 25 m^2.

.3 Locations: Garage Floor Slab, location as directed by Contract Administrator.

.4 Acceptable mock-ups may not remain as part of the Work.

.5 Intentionally damage part of exposed face for each finish, colour, and texture in the presence of the Contract Administrator. Demonstrate proposed methods and materials to be used for repairs to match adjacent undamaged surfaces.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, and handle materials in accordance with Section 01 61 00 – Common Product Requirements and:

.1 Delivery and Acceptance Requirements:

.1 Concrete hauling time: Deliver to site of Work and discharge within 120 minutes after batching.

.2 Modifying maximum time limit before receiving written acceptance from the Contract Administrator and concrete producer, as described in CSA A23.1/CSA A23.2, is prohibited.

.3 Submit deviations for review by Contract Administrator.

.4 Concrete delivery: Ensure continuous concrete delivery from plant meets CSA A23.1/CSA A23.2.

1.9 SITE CONDITIONS

.1 Placing concrete during rain or weather events that could damage concrete is prohibited.

.2 Protect newly placed concrete from rain or weather events in accordance with CSA A23.1/CSA A23.2.

.3 Cold Weather Protection:

.1 Maintain protection equipment in readiness on site.

.2 Use protection equipment when ambient temperature is below 5°C, or when temperature may fall below 5°C before concrete has cured.

.3 Placing concrete upon or against surface at temperature below 5°C is prohibited.

.4 Hot Weather Protection:

.1 Protect concrete from direct sunlight when ambient temperature is above 27°C.

.2 Prevent forms from getting too hot before concrete is placed. Apply accepted methods of cooling that will not negatively affect concrete.

.5 Protect concrete from drying.

2 Products

2.1 DESIGN CRITERIA

.1 To CSA A23.1/CSA A23.2, and as described in MIXES in this Section.

2.2 PERFORMANCE CRITERIA

.1 Quality Control Plan: Ensure concrete supplier meets performance criteria of concrete as established by the Contract Administrator and submit verification of compliance as described in ACTION AND INFORMATIONAL SUBMITTALS in this Section.

2.3 MATERIALS

.1 Portland Cement: GU and MS.

.2 Blended Hydraulic Cement: Type GUb.

.3 Water: To CSA A23.1/CSA A23.2.

.4 Aggregates: To CSA A23.1/CSA A23.2.

.5 Admixtures:

.1 Air entraining admixture: To ASTM C260/C260M.

.2 Chemical admixture: To ASTM C494/C494M. The Contract Administrator to review accelerating or set retarding admixtures during cold and hot weather placing.

.6 Shrinkage Compensating Grout: Premixed compound consisting of non-metallic aggregate, cement, and water reducing and plasticizing agents to CSA A23.1/CSA A23.2.

.1 Compressive strength: 40 MPa at 28 days.

.7 Non-Premixed Dry Pack Grout: Composition of non-metallic aggregate and cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 15 MPa at days.

.8 Post-Tensioning Ducts: To CSA A23.1/CSA A23.2.

.9 Curing Compound: To CSA A23.1/CSA A23.2.

.10 Waterstops: Ribbed extruded PVC of sizes indicated with shop welded corner and intersecting pieces with legs a minimum 150 mm long:

.1 Tensile strength: To ASTM D412, method A, Die C, minimum 9.5 MPa.

.2 Elongation: To ASTM D412, method A, Die C, minimum 250%.

.3 Tear resistance: To ASTM D624, method A, Die B, minimum 30 kN/m.

.11 Pre-Moulded Joint Fillers:

.1 Bituminous impregnated fibreboard: To ASTM D1751.

.2 Sponge rubber: To ASTM D1752, Type I.

.12 Weep Hole Tubes: Galvanized steel.

.13 Dovetail Anchor Slots: Minimum 0.6 mm thick galvanized steel with insulation filled slots.

.14 Concrete Bonding Agents: Epoxy to ASTM C881/C881M, Type V.

.15 Void Form: 150mm thick with strength and stiffness to support the weight of wet concrete but designed to collapse under long term sustained stress.

2.4 MIXES

.1 Alternative 1-Performance Method for Specifying Concrete: To meet Contract Administrator 's performance criteria to CSA A23.1/CSA A23.2.

.1 Concrete supplier to meet performance criteria as established below and verify compliance in accordance with the quality control plan.

.2 Provide concrete mix to meet following plastic state requirements:

.3 Workability: Free of surface blemishes, loss of mortar, colour variations.

.4 Provide concrete mix to meet Schedule A.

.5 Conduct trial batching for each Mix Type in Schedule A. Conduct testing of each trail batch to ensure the mix design meets the requirements of this specification and CSA A23.1. Submit testing of each trial batch to the Contract Administrator in accordance with Section 01 33 00 - Submittal Procedures prior to construction of the Work.

.6 Use accelerating admixtures in cold weather only when accepted by the Contract Administrator. If accepted, the use of admixtures will not relax cold weather placement requirements. Do not use calcium chloride.

SCHEDULE A – CONCRETE MIX

Spec. Ref.	CONCRETE TYPE	CONCRETE USE	CLASS OF EXPOSURE	MIN COMPRESSIVE STRENGTH	AIR CONTENT CATEGORY	MAX AGGREGATE SIZE	MAX CHLORIDE ION	OTHER REQUIREMENTS
1	STRUCTURAL AND NON-STRUCTURAL: Structural and non-structural elements exposed to chlorides, but without exposure to F/T	Ground floor slabs within the building, except for the Administration area	C-1	35 MPa @ 28 days	2	20 mm	.15%	-
2	Underground Structural and Non-structural Concrete	Piles, Pilecaps, Grade beams, Piers, Pit walls, Pit base slabs, Bollards, Pole-base caissons, Duct-banks	S-2	32MPa @ 56 days	2	20mm		
3.1	STRUCTURAL AND NON-STRUCTURAL: Structural and non-structural elements not exposed to chlorides, nor exposed to F/T	Ground floor slabs within the Administration area	N	35 MPa @ 28 days	Not rated	20 mm	.15%	-
3.2		Concrete on composite steel deck		25 MPa @ 28 days				
4	Non-STRUCTURAL: Non-structural elements exposed to chlorides and exposed to F/T	Exterior Slabs on grade, exterior ramps, apron slabs, curbs, gutters, and sidewalks	C-2	32 MPa	1	20 mm	.15%	Early Strength 70% fc' @ 24 hours.
5	NON-STRUCTURAL:	Lean Concrete	N	8 MPa	Not Rated	20 mm	.15%	-

3 Execution

3.1 PRE-INSTALLATION CONFERENCE

.1 Pre-Installation Conference for cast-in-place concrete: three (3) weeks prior to installation of concrete works, the Contractor shall conduct a meeting with mix designer, batch plant Quality Control Manager, Crystalline Waterproofing Additive Technical Representative, Third Party Testing Agency Representative, concrete installers, concrete finishers, waterstop installers, concrete curing applicators, concrete sealer Technical Representative, reinforcing steel installers, installers of work adjacent to or that penetrates the concrete works, and the Contract Administrator to review the following:

.1 General project requirements.

.2 Contractor's Quality Control Plan for each class of concrete.

.3 Contractor's procedures prior, during, and following concrete castings.

.2 Provide agenda and meeting minutes. Distribute agenda to the attendees four (4) days prior to the Pre-Installation Conference. Distribute Pre-Installation Conference meeting minutes within four (4) days of the meeting.

.3 Pay for all costs associated with the pre-installation conference excluding the Contract Administrator's cost.

3.2 PREPARATION

.1 Obtain Contract Administrator 's written acceptance before placing concrete.

.1 Provide a minimum of 24 hours notice before placing of concrete.

.2 Place concrete reinforcing in accordance with Section 03 20 00 – Concrete Reinforcing.

.3 During concreting operations:

.1 Prevent development of cold joints.

.2 Verify concrete delivery and handling facilitate placing with minimum amount of re-handling, and without damage to existing structure or Work.

.4 Pumping of concrete permitted only after acceptance of equipment and mix.

.5 Disturbing reinforcement and inserts during concrete placement is prohibited.

.6 Before placing of concrete, obtain Contract Administrator 's acceptance of proposed method for protection of concrete during placing and curing in adverse weather.

.7 Protect previous work from staining.

.8 Clean and remove stains before applying concrete finishes.

.9 Maintain accurate records of poured concrete items. Indicate date, location of pour, quality, workability, air content, temperature, and test samples taken.

.10 Drill holes in existing concrete in locations new concrete is dowelled to existing work.

.1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions indicated.

3.3 INSTALLATION/APPLICATION

.1 Perform cast-in-place concrete work in accordance with CSA A23.1/CSA A23.2.

.2 Sleeves and inserts:

.1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals, or columns, except where indicated or acceptable to the Contract Administrator.

.2 Where acceptable to the Contract Administrator, set sleeves, ties, pipe hangers, and other inserts and openings as indicated or specified elsewhere.

.3 Obtain the Contract Administrator's acceptance, in writing, before installing sleeves and openings greater than 100 x 100 mm that are not indicated in the reviewed Shop Drawings.

.4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written acceptance of modifications from the Contract Administrator before placing concrete.

.5 Confirm locations and sizes of sleeves and openings shown on Drawings.

.6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

.3 Anchor Bolt Installation:

.1 Set anchor bolts to templates in coordination with appropriate Subcontractor before placing concrete.

.2 Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written acceptance from Contract Administrator.

.1 Formed holes: Minimum 100 mm diameter.

.2 Drilled holes: To manufacturers' recommendations.

.3 Protect anchor bolt holes from water accumulation, and snow and ice build-ups.

.4 Set bolts and fill holes with epoxy grout.

.5 Locate anchor bolts used in connection with expansion shoes, rollers, and rockers taking into consideration ambient temperature at time of erection.

.4 Drain Hole and Weep Hole Installation:

.1 Form weep holes and drainage holes in accordance with Section 03 10 00 – Concrete Forming and Accessories. Remove woof forms, if used, after concrete has set.

.2 Install weep hole tubes and drains as indicated on Drawings.

.5 Dovetail Anchor Slot Installation: In accordance with Section 04 05 00 – Common Work Results for Masonry.

.1 Install continuous vertical anchor slot to forms where masonry abuts concrete wall or columns.

.2 Install continuous vertical anchor slots at 800 mm on-centre where concrete walls are masonry faced.

.6 Grout Installation Under Base Plates and Machinery: Use procedures in accordance with manufacturer’s recommendations which result in 100% contact over grouted area.

.7 Finishing and Curing:

.1 Finish concrete to CSA A23.1/CSA A23.2.

.2 Use procedures reviewed by the Contract Administrator or those noted in CSA A23.1/CSA A23.2 to remove excess bleed water. Ensure surface is not damaged.

.3 Cure concrete in accordance with CSA A23.1/CSA A23.2.

.4 Finish concrete floors to CSA A23.1/CSA A23.2, Class B.

.5 Provide scratch where floor tile will be applied. Provide depressions to accommodate floor tile if indicated on architectural drawings.

.6 Provide concrete finish as per Section 03 35 00.

.7 Rub exposed sharp edges of concrete with carborundum to produce a minimum 3 mm radius edges unless otherwise indicated.

.8 Waterstop Installation:

.1 Install waterstops to provide continuous water seal.

.2 Do not distort or pierce waterstops in way as to hamper performance.

.3 Do not displace reinforcement when installing waterstops.

.4 Use equipment to manufacturer's requirements to site splice waterstops.

.5 Tie waterstops rigidly in place.

.6 Use straight, heat-sealed butt joints on site only. All other types of joints, including but not limited to T-shaped, L-shaped or Cross Shaped joints, must be shop welded.

.7 Use shop welded corners and intersections unless otherwise acceptable to the Contract Administrator.

.9 Joint Fillers Installation:

.1 Provide filler for each joint in single piece for depth and width required for joint, unless otherwise acceptable to the Contract Administrator.

.2 When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

.3 Locate and form isolation joints as indicated on Drawings.

.4 Install joint filler.

.5 Use 10 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

.10 Dampproofing Installation:

.1 Install dampproofing membrane under concrete slabs-on-grade inside building.

.2 Lap dampproofing membrane minimum 150 mm at joints and seal.

.3 Seal punctures in dampproofing membrane before placing concrete.

.4 Use patching material minimum 150 mm larger than puncture and seal.

3.4 TOLERANCES

.1 Concrete Surface Tolerance: To CSA A23.1/CSA A23.2 FF = 25: FL 20.

3.5 SITE QUALITY CONTROL

.1 Site Tests: Conduct tests and submit report as described in ACTION AND INFORMATIONAL SUBMITTALS in this Section.

.1 Concrete pours

.2 Slump

.3 Air content

.4 Compressive strength at 7, 28, and 56 days

.5 Air and concrete temperature

.2 Inspection and testing of concrete and concrete materials carried out by testing laboratory designated by the Contract Administrator in accordance with CSA A23.1/CSA A23.2.

.3 The Testing agency will take additional test cylinders during cold weather concreting. Cure cylinders on Project site under same conditions as concrete which they represent.

.4 Non-Destructive Methods for Testing Concrete: To CSA A23.1/CSA A23.2.

.5 Inspection or testing by the Contract Administrator does not augment or replace Contractor's quality control or relieve the Contractor of contractual responsibility.

3.6 CLEANING

.1 Clean in accordance with Section 01 74 00 – Cleaning and:

.1 Provide appropriate area on Project site where concrete trucks can be safely washed.

.2 Manage waste in accordance with Section 01 74 19 – LEED Construction Waste Management and:

.1 Divert unused concrete materials from landfill to local facility.

.2 Divert unused admixtures and additive materials (pigments, fibres, etc.) from landfill to official hazardous material collections site.

.3 Prevent disposal of unused admixtures and additive materials, concrete, concrete washwater, or cleaning materials and residues into sewer systems, lakes, streams, onto ground, or in other locations that pose a health or environmental hazard.

.4 Prevent admixtures and additive materials from entering drinking water supplies or streams.

.5 Collect liquid or solidify liquid with inert, noncombustible material and remove for disposal.

3.7 PROTECTION

.1 Do not place load upon new concrete until authorized by the Contract Administrator.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

1. General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

1. Work of this Section includes the following:
    1. Requirements for concrete floor additives such as:
        1. Penetrating sealer
        2. Hardener additive
        3. Coloured concrete pigments
    2. Testing and measurement for floor flatness and levelness,
    3. Trowelling, levelling, and floating of floor surfaces for ready for applied finishes.

1.3 REFERENCE STANDARDS

1. Canada Green Building Council (CaGBC):
    1. LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.
2. American Society for Testing and Materials (ASTM International):
    1. ASTM C309, Standard Specification for Liquid Membrane-Forming Compound for Curing Concrete
    2. ASTM C873/C873M, Standard Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
    3. ASTM C979/C979M, Standard Specification for Pigments for Integrally Colored Concrete
3. American Concrete Institute (ACI):
    1. ACI 117, Specifications for Tolerances for Concrete Construction and Materials and Commentary
    2. ACI 302.1, Guide for Floor and Slab Construction
4. Canadian Standards Association (CSA Group):
    1. CSA A23.1, Concrete Materials and Methods of Concrete Construction/
    2. CSA A23.2, Test Methods and Standard Practices for Concrete
    3. CSA A283, Qualification Code for Concrete Testing Laboratories
5. International Concrete Repair Institute (ICRI):
    1. ICRI 310.2, Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays and Concrete Repair

1.4 DEFINITIONS

1. Floor Classifications: Classification of concrete floor slabs based on their intended use, methods of finishing and finish materials applied to flooring as denoted by the Frating below, and as follows:
    1. Single Course Floor: Floors placed in a single course with final finishing applied to properly levelled concrete.
2. Finish or Finishes: Materials applied to finished concrete surface, i.e.: stained or coloured concrete, carpet, resilient flooring, or ceramic tile.

3. Finishing: Methods, tools and equipment employed to achieve levelness or surface flatness for shored slabs and slabs on grade, refer to room finishes schedule indicated and as follows:

    1. F2Finishing: Floors having a straightedge value of ±6 mm over 3048 mm (±1/4" over 10'); similar to CSA A23.1 Class B Slab Finishing.

    2. F3Finishing: Floors having a straightedge value of ±1.6mm over 3048mm (1/16" over 10'); similar to CSA A23.1 Class C Slab Finishing.

1.5 ADMINISTRATION REQUIREMENTS

1. Coordination: Coordinate a meeting between the Contractor, Subcontractor responsible for concrete placement, and the Contract Administrator to determine Site Quality Control testing section borders and sample measurement line locations, method of measurement, and accuracy requirements of the measuring devices.

2. PreConstruction Meetings: Arrange meeting with Contractor, Subcontractor for work of this Section and other Subcontractors affected by work of this Section to discuss effects and issues governing installation of concrete finishing materials; prepare an outline agenda for the meeting.

1.6 SUBMITTALS

1. Action Submittals: Provide the following submittals before starting any work of this Section:

    1. Product Data: Submit manufacturer's product data for each materials specified including recommended application coverage rates and methods of installation.

    2. Shop Drawings: Submit shop drawings indicating proposed construction joints, isolation joints, expansion joints and contraction joints before preconstruction meeting ready for discussion and confirmation.

2. Informational Submittals: Provide the following submittals during the course of the work:

    1. Submit results for straightedge measurements to demonstrate compliance with specified tolerances. Record the following information on a drawing indicating floor slab layout, column locations and slab penetrations:

        1. Indicate variance from specified straightedge measurements as a + or value.
        2. Failed tests in excess of 50% of the straightedge will require the Subcontractor to flash patch floor to achieve specified tolerance, example of tolerance failure.
        3. SlabsOnGrade: Measurement of 1.6mm or greater than ± 6mm measurement will be considered as a failed test and will require flash patching.
        4. Suspended Slabs: Measurement of 3mm or greater than ± 6mm measurement (80% tolerance allowance) will be considered as a failed test and will require flash patching.

3. Sustainable Design Submittals:

    1. Submit LEED submittal forms verifying products contain less than 100g/l of VOC in accordance with SCAQMD Rule #1113.

1.7 PROJECT CLOSEOUT SUBMISSIONS

1. Operation and Maintenance Data: Submit detailed cleaning and maintenance instructions for concrete densifier products and instruct the City in proper care and maintenance of specified floor finishes, including a complete list of floor care products that will be required for ongoing maintenance.

1.8 QUALITY ASSURANCE

1. Qualifications:

    1. Work of this Section shall be executed by a company that has adequate equipment and skilled tradesmen to perform it expeditiously and is known to have been responsible for satisfactory installations similar to that specified, during a period of at least the immediate past five years.

2. Co-operation:

    1. Ensure that concrete supplied for slabs contains no admixtures which would be incompatible with floor finishing materials.

1.9 SITE CONDITIONS

1. Environmental Requirements:

    1. Ensure that adequate temporary heating is provided as required for cold weather work.

    2. Provide adequate moisture, sunshades and wind barriers to prevent too rapid drying of concrete during hot weather.

2. Protection:

    1. Ensure that finished concrete floor areas are protected from abrasion from foot or wheeled traffic, and from damage caused by spillage of oil or other harmful materials.

2 Products

2.1 MANUFACTURERS

1. Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; manufacturers listed as additional Acceptable Products and that offer similar products may be incorporated into the work of this Section, provided they meet the performance requirements established by the named products.

2. Acceptable Products Manufacturers: Subject to compliance with requirements specified in this Section, use any of the following listed manufacturers' products, Choose an item. provided required product data and shop drawing are submitted before starting any work of this Section:

    1. Davis Colors Inc.

    2. Solomon Colors Inc.

3. Substitutions: Additional manufacturers offering similar products to Acceptable Products Manufacturers listed above may be incorporated into the work provided they meet the performance requirements established by the named products and provided they submit requests for substitution a minimum of ten (10) days prior to Bid Closing.

2.2 MATERIALS

1. Unless specified otherwise, materials shall meet specified requirements of Section 03 30 00 – Cast-in-Place Concrete.

2. Curing Sheet: 50 um (2 mil) polyethylene sheet conforming to CGSB 51-GP-51M or laminated waterproof kraft paper.

3. Liquid Applied Penetrating Sealer: Clear water-based silane micro emulsion penetrating concrete sealer formulated to prevent water and chloride intrusion into concrete surfaces.

    1. Basis of Design Materials:

        1. Cipadm S-40 by CPD Construction Products
        2. Sikagard SN40 by Sika Canada Inc.
        3. Hydrozo Silane 40 VOC by BASF.

4. Hardener Aggregate: Pre-mixed, non-metallic aggregate, dry shake hardener.

    1. Basis of Design Materials:

        1. Floor Hardener Pre-Mix by CPD Construction Products
        2. Diamag 7 by Sika Canada Inc.
        3. MasterTop 100 by BASF.

5. Underlayment:

    1. Concrete Substructure: Cementitious, self levelling, single component, polymer modified underlayment and manufacturer's recommended primer, for application thicknesses to a minimum feather edge to 13mm (1/2"); acceptable.

        1. Basis of Design Materials:

            .1 Planipatch by MAPEI Canada Inc.

            .2 Sika Level 125CA by Sika Canada Ltd.,

            .3 Sure-Flo PLUS by Gemite Products Inc.

    2. Plywood Substructure: Gypsum cement, self leveling, single component underlayment; having a minimum compressive strength of 24 MPa (3,500 psi) and minimum density of 1890 kg/m^3 (120 pounds per cubic foot).

        1. Basis of Design Material:

            .1 Levelrock 3500 by USG.

        2. Primer and Sealer: As recommended by gypsum cement manufacturer.

6. Overlayment: Cementitious, self levelling, single component, polymer modified overlayment, for application thicknesses to a minimum of 13mm to 25mm (1/2" to 1").

    1. Basis of Design Materials:

        1. Sikafloor Level 25CA by Sika Canada Ltd.
        2. Sure-Flo FT100 by Gemite Products Inc.

7. Topping: Cementitious, self levelling, single component, polymer modified overlayment, for application thicknesses to a minimum of 19mm to 50mm (3/4" to 2").

    1. Basis of Design Materials:

        1. Mapecem Premix by MAPEI Canada Inc.
        2. Sikafloor Level 25CA by Sika Canada Ltd.
        3. Gem-Crete TO ST by Gemite Products Inc.

8. Patching and Flash Patching Materials: Cementitious based, polymer modified, fine aggregate, single component, rapid curing, early strength floor patching compounds having high adhesion, for application in thicknesses to a minimum of 3 mm to 25 mm (1/8" to 1").

    1. Basis of Design Materials:

        1. Mapecem 100 by MAPEI Canada Inc.
        2. SikaQuick 1000 by Sika Canada Ltd.
        3. MeadowCrete H by W.R. Meadows of Canada

9. Joint Sealant: Refer to Section 07 92 00 – Sealants.

3 Execution

3.1 EXAMINATION

1. Before commencing work, ensure that surfaces are acceptable to receive and maintain concrete finishing, and that specified installation will be achieved.

3.2 FINISHING FLOORS AND SLABS

1. Finish floors and slabs in accordance with CSA A23.1 and ACI 302.1 recommendations for screeding, restraightening, and finishing operations for concrete surfaces; do not wet concrete surfaces.

3.3 INSTALLATION

1. Concrete Finishing:
    1. Roll or tamp concrete to force coarse aggregate into concrete mix and then screed.
    2. Bring surface to true grade by floating.
    3. Steel trowel to a true and even surface.
    4. Follow with second steel trowelling to produce a smooth burnished surface.
2. Sealed Floors:
    1. Seal all exposed concrete floors. Apply sealer as recommended by manufacturer. Install bond breaker of silica sand, polyethylene film strip or foam filler in bottom of joints.
3. Hardened Floors:
    1. Apply hardener aggregate to floor surfaces indicated on drawings and/or schedules in two shakes, half of the aggregate for each shake.
    2. Apply first shake when the concrete is firm enough to support workmen and equipment and when no standing water is present. Mechanically float aggregate into surface.
    3. Apply the second shake and mechanically float as specified above for finishing.
    4. Apply total amount of aggregate at rate of 3 kg/ m^2 (60-100 lbs. per 100 sq.ft.) of floor area.
    5. Cure concrete as specified in CAN/CSA-A23.1/A23.2, and as indicated in Paragraph 3.4 - Concrete Finishing Schedule. Ensure that no curing compound is used which is detrimental to bond of bedding for finish flooring or finish flooring materials.
4. Floor Underlayment:
    1. Leak Prevention: Fill cracks and voids in subfloor where leakage of slurry could occur using suitable quick setting patch material or caulk, as recommended by underlayment manufacturer.
    2. Prime substrate according to manufacturer’s recommendations.
    3. Installation shall not begin until building is enclosed.
    4. Install sound attenuation mat where required on drawings, complete with isolation strips, prior to pouring floor underlayment.
    5. Mix underlayment in accordance with manufacturer’s written instructions and test mix for slump using 100mm (4") cylinder.
    6. Pour underlayment to recommended thickness and immediately spread and screen to smooth surface.
5. Overlayment and Topping:
    1. Apply materials as per the manufacturer’s written instruction.
    2. Prepare and primer substrate, fill joints and cracks with caulking material as per manufacturer’s recommendations.
    3. Mix material to manufacturer’s written instructions.
    4. Pour and apply to surface thoroughly to thickness, screen to smooth surface.
6. Control Joints:
    1. As soon as concrete surface is firm enough not to be torn or damaged by cutting, cut 5mm (3/16") wide control joints into surface of concrete with abrasive blade power saw.
    2. Locate control joints on centre lines of columns, and at maximum spacing of 6096mm (20') in both directions unless noted.
    3. Cut joints in slabs on grade 38mm (1-1/2") deep.

4. Within four (4) weeks of cutting joints, fill them with joint sealant. Completely clean side joint surfaces of dirt, oil, grease, and similar contaminants. Mask floor surfaces at joints while pouring. Prime side joint surfaces with compatible primer if surfaces are not completely dry.

7. Cast-in all items as supplied by other Sections.

3.4 PATCHING AND REFINISHING

1. Before completion of project, patch and refinish defective surfaces to match surrounding areas with no discernible variation in appearance.

3.5 CONCRETE FINISHING SCHEDULE

1. Exposed Concrete:
    1. Steel trowel finish, cured by liquid curing-sealing compound.
2. Polished Concrete Floor Finish:
    1. Steel trowel finish, cured by curing sheet or moist curing.
3. For Carpet and Carpet Tile Flooring:
    1. Steel trowel finish, cured by compatible curing compound, curing sheet or moist curing.
4. For Resilient Tile Flooring:
    1. Steel trowel finish, cured by compatible curing compound, curing sheet or moist curing.
5. For Ceramic Tile and Quarry Tile:
    1. Installed with thin set mortar: light steel trowel finish, cured by curing sheet or moist curing.
6. For Depressed Slabs:
    1. Rough broom finish, cured by curing sheet or moist curing.
7. Concrete Bases and Curbs for Equipment:
    1. Hand trowel finish.
8. For Loading Dock area and other areas indicated on Drawings and Schedules:
    1. Hardened concrete floor, cured with compatible curing-sealing compound.
    2. Prepare concrete floors in strict accordance with the manufacturer's written instructions, sweeping all areas to receive floor sealer/densifier with powered fine bristle broom floor cleaner, scrubbing off or cleaning by high pressure water method to remove all surface dust, dirt and contamination, and let dry.
9. Concrete Vehicle Ramps/Pads:
    1. Steel trowel "swirl" finish with herringbone pattern traction grooves.
    2. Make herringbone pattern traction grooves by accurately cutting out grooves with abrasive blade power saw. Provide 38 mm (1-1/2") wide x 38 mm (1-1/2") deep herringbone pattern traction grooves at 610 mm (24") O.C., which slope down from edges of ramp at 45º angle to continuous 75 mm (3") wide x 38 mm (1-1/2") deep centre groove which runs up centre of ramp slope.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes supply and installation of unit masonry assemblies consisting of the following:

.1 Concrete Masonry Units (CMU).

.2 Masonry accessories.

.3 Site quality control.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 American Concrete Institute: (ACI):

.1 ACI 530.1/ASCE 6/TMS 602, Commentary on Specification for Masonry Structures

.3 Brick Institute Association (BIA)

.1 BIA Technical Notes 20, Cleaning Brickwork

.2 BIA Technical Notes 23A - Efflorescence, Causes and Prevention

.4 Canadian Standards Association (CSA):

.1 CSA A165, CSA Standards on Concrete Masonry Units

.2 CSA A179, Mortar and Grout for Unit Masonry

.3 CSA A370, Connectors for Masonry

.4 CAN/CSA A371, Masonry Construction for Buildings

.5 CSA S304.1, Design of Masonry Structures

.6 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction

.5 American Society for Testing of Materials (ASTM):

.1 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM A153/A153M, Standard Specification for Zinc Coating (HotDip) on Iron and Steel Hardware

.3 ASTM A496/A496M, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement

.4 ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts

.5 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.6 ASTM A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

.7 ASTM C67, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.

.8 ASTM C207, Standard Specification for Hydrated Lime for Masonry Purposes

.9 ASTM C270, Standard Specification for Mortar for Unit Masonry.

.10 ASTM C494, Standard Specification for Chemical Admixtures for Concrete.

.11 ASTM C568/C568, Standard Specification for Limestone Dimension Stone

.12 ASTM E488/E488M, Standard Test Methods for Strength of Anchors in Concrete Elements

.13 ASTM E514/E514M, Standard Test Method for Water Penetration and Leakage Through Masonry

.14 ASTM E2556/E2556M, Standard Specification for Vapour Permeable Flexible Sheet Water Resistive Barriers Intended for Mechanical Attachment.

.15 ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

.16 ASTM F594, Standard Specification for Stainless Steel Nuts

.6 Canadian Concrete Masonry Producer Association (CCMPA):

.1 CCMPA Metric Technical Manual

.7 Underwriters Laboratories of Canada (ULC):

.1 ULC List of Equipment and Materials for Fire Rated Construction

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

.1 Coordinate with other work having a direct bearing on work of this Section.

.2 Coordinate the masonry work with anchor requirements at framed openings.

.3 Coordinate the masonry work with air barrier installation to achieve continuous monolithic air barrier.

1.5 SUBMITTALS

.1 Samples: Submit samples of the following; stone tile panel, concrete block, mortar, masonry reinforcement, ties and anchors, damp course/thru-wall flashing and adhesive, metal drip flashing, mortar dropping control device and weepholes for Contract Administrator's approval before commencing work of this section.

.2 Shop Drawings: Submit shop drawings indicating the following:

.1 Indicate sizes, profiles, coursing, and locations of special shapes for concrete masonry units and stone masonry cladding.

.2 Indicate sizes, profiles, and locations of each stone trim unit required.

.3 Detail corner units, end dam units, and other special applications for fabricated flashings.

.3 Samples for Verification: Submit samples for verification for each type and colour of the following:

.1 Decorative stone masonry cladding units, in the form of small scale units.

.4 Informational Submittals: Provide the following submittals when requested by the Contract Administrator:

.1 Submit ULC Assembly Listings and Materials cut sheets for fire rated assemblies as follows:

.1 Not later than 30 working days following Award of Contract, submit copies of ULC Assembly and Materials Listing for indicating ULC Number and how assembly meets the rating criteria for assemblies listed on drawings or meets requirements of the Building Code and local authorities of jurisdiction.

.2 Use the same system and material as would be required for a tested assembly for the project; ULC Listings are tested with the specific materials indicated; substitutions will not be permitted unless evidence of equivalency is confirmed.

.3 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site; include manufacturer's printed instructions for installation.

.5 Certificates: Submit statements of material properties indicating compliance with specified requirements for each type and size of the following:

.1 Masonry Units:

.1 Include material test reports substantiating compliance with requirements.

.2 Include ULC Listings for fire resistance rated materials and construction equivalent to assemblies with indicated on drawings indicating fire resistance ratings.

.2 Cementitious Materials:

.1 Include brand, type, and name of manufacturer for site mixed mortar materials.

.2 Include description of type and proportions of ingredients for pre-blended, dry mortar mixes.

.3 Include description of type and proportions of ingredients for grout mixes.

.3 Accessories:

.1 Reinforcing bars

.2 Joint reinforcement

.3 Anchors, ties, and metal accessories

.4 Site Quality Control Submissions: Submit detailed description of methods, materials, and equipment used in accordance with cold or hot weather requirements; and proposed unit masonry cleaning techniques.

.6 Sustainable Design Submittals:

.1 LEED Submittals: submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Documentation including mix design identifying percent of recycled material used in concrete masonry units

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance to the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20% of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project.

1.6 SITE CONDITIONS

.1 Protection of Masonry: Protect masonry and other work from marking and other damage and as follows:

.1 Cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work during construction until permanent flashings and membranes are completed.

.2 Cover partially completed masonry when construction is not in progress to prevent wetting of inside wythes of construction and contribution to efflorescence.

.3 Extend cover a minimum of 610 mm (24") down both sides and hold cover securely in place.

.4 Secure cover a minimum of 610 mm (24") down face next to un-constructed wythe and hold cover in place where 1 wythe of multi-wythe masonry walls is completed in advance of other wythes.

.5 Provide adequate bracing for masonry during construction and until permanent lateral supports are in place.

.6 Do not apply uniform floor or roof loads for a minimum of 12 hours and concentrated loads for a minimum of 3 days after building masonry walls or columns.

.2 Cold Weather Protection:

.1 Keep masonry materials completely free from ice and frost. Use approved smokeless heaters. Do not use scorched sand. Do not use salts, admixtures or antifreezes.

.3 Conform to the following construction requirements:

AIR TEMPERATURE	HEATING OF MATERIALS	PROTECTION
Above 5 deg C	Normal masonry procedures	Cover walls and materials
Below 5 deg C	Heating mixing water. Maintain mortar temperatures between 5 deg C and 50 deg C until placed	Cover walls and materials to prevent wetting and freezing.
Below 0 deg C	In addition to above heat sand. Thaw frozen sand and frozen wet masonry units before use.	With wind velocities over 35 km/h provide windbreaks during the workday and cover walls and materials at the end of each workday to prevent wetting and freezing. Maintain masonry above 0 deg C by using auxiliary heat or insulated blankets for 16 hours after laying masonry units.
Below -6 deg C	In addition to above heat dry masonry units to -6 deg C	Provide enclosure and supply sufficient heat to maintain masonry enclosure above 0 deg C for 24 hours after laying masonry units.

.4 Hot Weather Requirements

.1 Comply with hot weather construction requirements contained in reviewed submittals.

.2 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

.3 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Delivery and Acceptance Requirements: Deliver pre-blended, dry mortar mix in moisture resistant containers designed for lifting and emptying into dispensing silo; store dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

.2 Storage and Handling Requirements: Store masonry units on elevated platforms in a dry location and as follows:

.1 Stack materials on floors of building so that structural design loads are not exceeded; coordinate with Contract Administrator.

.2 Cover tops and sides of stacks with waterproof sheeting securely tied to pallets if units are not stored in an enclosed location; do not install masonry units that become wet until they are dry.

.3 Store cementitious materials on elevated platforms, under cover, and in a dry location; do not use cementitious materials that have become wet or damp.

.4 Store aggregates where grading and other required characteristics can be maintained; store to prevent contamination by substances deleterious to performance and appearance.

.5 Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

2 Products

2.1 CONCRETE MASONRY UNITS

.1 Standard concrete blocks shall be autoclave or bubble cure process, high pressure steam cured, modular, conforming to CSA A165, with lineal shrinkage and moisture movement not to exceed 0.035% and shall be as follows;

.1 Classification: S/15/A/M, 75% solid for all locations where structural members bear on concrete block.

.2 H/15/A/M, for all other block work.

.3 Size: Modular imperial to sizes indicated on Drawings.

.4 Special shapes:

.1 Provide square units for exposed corners.

.2 Provide purpose made shapes for lintels and bond beams.

.3 Provide additional special shapes required for project.

.4 Manufacture special shapes at same time and with the same batch as standard concrete block to be used.

.5 Lightweight concrete masonry units not allowed to be used in this project.

.2 Fire Resistant Concrete Masonry Units:

.1 CAN/CSA-A165 Series, same classification as non-rated block units except aggregate used in units and equivalent thickness of units to comply with applicable Code for fire-resistance ratings indicated. For fire rated walls requiring a fire-resistance rating of 3 hours or greater, use ULC certified units.

.3 Size: Modular to sizes indicated on Drawings.

.4 Where concrete block walls are required as fire separations or barriers, they shall conform to the National Building Code. With respect to equivalent thickness and type of concrete. Consult with Contract Administrator for locations and special conditions.

.5 Exposed block shall all be made by one manufacturer and shall be uniform in colour, shade and texture.

2.2 MORTAR MATERIALS

.1 Mortar materials shall conform to CSA A179.

.2 Water: Potable (clean, exempt of ice, oils, acid, alkalis, organic matter, sediments or any other harmful matter). CSA A179.

.3 Aggregate:

.1 CSA A179.

.2 Use same brands of materials and source of aggregate for entire project.

.3 Use washed aggregate consisting of natural sand or crushed stone for mortar that is exposed to view.

.4 Cement: Normal portland, in accordance with CSA A3000, Type GU.

.5 Grout: In accordance with CSA A179, Table 3.

.6 Hydrated Lime: ASTM C207, Type S.

.7 Cold Weather Admixture:

.1 Non-chloride, non-corrosive, accelerating admixture in accordance with CSA A179 and ASTM C494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

.2 Acceptable Materials:

.1 Morset by GCP Applied Technologies.

.2 MasterSet AC 534 by Master Builders Solutions Canada.

.3 SikaCem Accelerator by Sika Canada.

2.3 MORTAR MIXES

.1 Mixing:

.1 Prepare and mix mortar materials under strict supervision and in small batches for immediate use only. Mix proprietary mortars in strict accordance with CSA A179. Do not use re-tempered mortars for coloured mortars.

.2 For Masonry Below Grade and in Contact with Earth:

.1 Use premixed silo or bagged Type 'S' masonry cement mortar having minimum compressive strength of 8.5 MPa at 28 days, jobsite tested.

.3 For Exterior Wythe of Cavity/ Composite Walls (non load-bearing, above grade):

.1 Use Type 'N', 1:1:6 pre-mixed, pre-coloured, Portland cement/lime/sand mortar, Betomix Plus by Daubois Inc., or by Maxi-Mix silo. Use non-staining "white" cement where required to achieve colour as selected later by the Contract Administrator.

.4 Interior Reinforced or Non-Reinforced Block Walls:

.1 Use Type 'S', premixed Bloc Mix by Daubios Inc., or approved equal by Maxi-Mix.

.5 For All Other Masonry:

.1 Use Type 'N', premixed silo or bagged masonry mortar having a minimum compressive strength of 3.5 MPa at 28 days, jobsite tested as per property specification, Table 6, CSA A179.

2.4 MASONRY REINFORCEMENT, TIES AND ANCHORS

.1 Masonry Joint Reinforcement: In accordance with to CSA A371 and ASTM A496/A496M, with corrosion protection in accordance with CSA S304.1 and CSA A370, and as follows:

.1 Interior Walls: Hot dip galvanized, carbon steel.

.2 Exterior Walls: Stainless steel.

.3 Lengths: A minimum of 3050 mm (10') with prefabricated corner and tee units.

.2 Connectors: In accordance with to CSA A370 and CSA S304.1 with hot dip galvanized finish.

.3 SingleWythe Masonry Joint Reinforcement: Either ladder or truss type with single pair of side rods.

.4 Ties and anchors specified in this section shall be designed in accordance with CSA A370 for non-conventional masonry connectors as follows:

.1 Deflection: Maximum 1.6 mm (1/16") including free play, when acted upon by a lateral load of 0.45 kN, in all possible positions of adjustment.

.2 Positive restraint at position of maximum adjustment.

.3 Free play of multi-component ties maximum 0.8 mm (1/32") when assembled in all possible configurations.

.4 Anchors shall allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall.

.5 Lateral Partition Supports (Top of Wall Anchors):

.1 Angle Support: Fabricated from 3 mm (1/8") core metal thickness angled steel plate having 75 mm (3") long legs fastened to deck structure to allow vertical movement of masonry assembly; hot dip galvanized; coordinate with Section 07 84 00 – Firestopping and Smokeseals for firestopping insulation and smoke seals.

.2 Plate Support: Fabricated from 3 mm (1/8") core metal thickness stainless steel plate with 9.5 mm (3/8") diameter metal 150 mm (6") long welded to plate having closed end plastic tube fitted over rod that allows rod to move in and out of tube.

.3 Anchor Bolts: Where required provide Headed or L-shaped steel bolts in accordance with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers; hot-dip galvanized in accordance with ASTM A153/A153M, Class C.

.4 Post Installed Anchors: Provide chemical anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete when tested in accordance with ASTM E488/E488M conducted by a qualified independent testing agency, and as follows:

.1 Indoor Locations: Carbon-steel components zinc-plated in accordance with ASTM B633, Class Fe/Zn 5.

.2 Outdoor and High Humidity Locations: Alloy Group 1 or 2 stainless steel bolts complying with ASTM F593 and nuts complying with ASTM F594.

.3 Fastening into Solid Concrete or Solidly Grouted Installation: Two component, injectable adhesive specifically manufactured for use in installing dowels or threaded anchor rods and inserts into new or existing concrete or grout. Basis-of-Design Materials: Hilti Inc., HIT HY150 System, no Substitutions Accepted.

.4 Fastening Trough Hollow Wall Installation: Two component, injectable adhesive specifically manufactured for use in installing dowels or threaded anchor rods and inserts, with cylindrical mesh screen tube into new or existing masonry cavity wall. Basis-of-Design Materials: Hilti Inc., HIT HY20 System, no Substitutions Accepted.

.6 Galvanizing for Masonry Reinforcement, Ties and Anchors:

.1 Hot Dip Hardware and Bolts: In accordance with ASTM A153/A153M, Class B-2 regardless of location.

.2 Hot Dip Sheet Steel: In accordance with ASTM A653/A653M, Coating Designation Z600, regardless of location.

.3 Structural Shapes and Pipes: In accordance with ASTM A123/A123, Grade 85, regardless of location.

2.5 MISCELLANEOUS MASONRY ACCESSORIES

.1 Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation 2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

.1 Products: Subject to compliance with the requirements of this Section, provide:

.1 RS Series – Rubber Control Joints by Hohmann & Barnard, Inc.

.2 Packing Insulation: Loose, mineral wool insulation, 16 kg/m^3 (1.0 lbs./cu.ft.) density, and conforming to CAN/CGSB-51.11, as indicated in Section 07 21 16 – Blanket Insulation and Vapour Barrier.

.3 Firestopping: As specified under Section 07 84 00 – Firestopping and Smokeseals.

.4 Sealants: As specified under Section 07 92 00 – Sealants.

.5 Support Angle:

.1 Hot dip galvanized 458 g/m5/side in accordance with CSA A370 and ASTM A153/A153M.

.6 Fasteners: Galvanized fasteners meeting the requirements of ASTM A325, and as recommended by manufacturer.

.7 Joint Filler:

.1 Compressible Filler: Pre-moulded filler strips in accordance with ASTM D1056, Grade 2A1; compressible up to 35%; of width and thickness indicated; formulated from neoprene, urethane or PVC.

.8 Bond Breaker Strips: #15 asphalt saturated, organic roofing felt in accordance with CSA A123.3.

3 Execution

3.1 EXAMINATION

.1 Verify that field conditions are acceptable and are ready to receive work.

.2 Verify items provided by other sections of work are properly sized and located.

.3 Verify that built-in items are in proper location, and ready for roughing into masonry work.

.4 Verify walls including steel connections n walls to be grouted have been inspected by Contract Administractor, before grouting.

3.2 PREPARATION

.1 Direct and coordinate placement of metal anchors supplied to other Sections.

.2 Provide temporary bracing and shoring during installation of masonry work. Maintain in place until building structure provides permanent bracing.

.3 Protect materials and adjacent construction mortar droppings and damage during construction.

.4 Plug grouting clean-out holes with block masonry units. Brace masonry for wet grout pressure.

3.3 COURSING

.1 Build masonry plumb, level, and true to line, with vertical joints in alignment.

.2 Establish lines, levels, and coursing indicated. Protect from displacement.

.3 Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

.4 Concrete Masonry Units:

.1 Bond: Running; stack bond for walls indicated with vertical bar reinforcing.

.2 Coursing: One unit and one mortar joint to equal 200 mm (8”).

.3 Mortar Joints: Concave where exposed or where paint or other finish coating is indicated; flush for concealed joints. Cut mortar joints flush where resilient base, wall tile, parging, air barrier or insulation is scheduled.

3.4 PLACING AND BONDING

.1 Lay hollow masonry units with face shell bedding on head and bed joints.

.2 Reinforced Masonry: Lay masonry units with core cells vertically aligned clear of mortar and unobstructed. Place mortar in masonry unit bed joints back 6 mm (1/4”) from edge of unit grout spaces, bevel back and upward.

.3 Where indicated, provide special shape units.

.4 Exposed Faces: Lay face work from face side with exposed face flush.

.5 Buttering corners of joints or excessive furrowing of mortar joints are not permitted.

.6 Remove excess mortar as work progresses.

.7 Interlock intersections and external corners of walls with running bond.

.8 Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

.9 Perform job site cutting of masonry units with power-driven abrasive discs to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges. Allow 3 mm (1/8”) clearance around items penetrating or built into walls.

.10 Isolate masonry from vertical structural framing members with a control joint.

.11 Isolate top joint of masonry from horizontal structural framing members and slabs or decks with compressible joint filler. Finish resulting joint with Sealant.

.12 Fill masonry cores with grout at:

.1 Ends of walls, both free and abutting other work.

.2 Jambs of openings, minimum 300 mm (12") from jamb face.

.3 Courses under plates and lintel requiring bearing.

.4 Attachment devices for fixtures and built-in items.

.5 Courses at tops of fire rated walls.

.6 Blocks of parapet walls, and in accordance with CSA-A371, Appendix G1.

.7 Anchors set in block cells.

.8 Install building paper below voids to be filled with grout; keep paper 25 mm (1") back from face of units.

3.5 CONTROL AND EXPANSION JOINTS

.1 General: Install control and expansion joint materials in unit masonry where indicated and not to exceed 6 metres (20') on center and 3 metres (10') from corners. Build-in related items as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

.2 Form control joints in concrete masonry as follows:

.1 Install preformed control-joint gaskets designed to fit standard sash block.

.2 Keep head joints free and clear of mortar for application of sealant.

3.6 PROVISION FOR MOVEMENT

.1 Leave space of dimension indicated between top of non-loadbearing wall and structural elements. Do not use wedges.

3.7 REINFORCEMENT AND ANCHORAGE

.1 Install reinforcement and anchorage to CSA-A370, CSA-A371 and CSA-S304.1 and as indicated.

.2 Install masonry joint reinforcement as indicated. Where not indicated provide as follows:

.1 Install horizontal joint reinforcement 400 mm (16") on centre. For stack bond, place joint reinforcement at every course.

.2 Place reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm (16") each side of opening.

.3 Place reinforcement continuous in first and second joint below top of walls.

.4 Lap joint reinforcement ends minimum 150 mm (6").

.3 Bar Reinforcing Steel:

.1 Secure reinforcing steel in place. Provide bar sizes, laps and spacings as indicated. Maintain position within 13 mm (1/2") of dimensioned position.

.2 Unless otherwise indicated locate vertical reinforcing on centreline of units.

.3 Unless otherwise indicated, reinforce stack-bonded unit joint corners and intersections with strap anchors 400 mm (16") on centre.

.4 Secure reinforcing steel in place. Inspect steel connections before grouting.

.5 Provide cleanout openings at bottom of cores containing reinforcement.

.6 Fill cells containing reinforcement and anchor bolts solidly with grout.

.4 Anchorage:

.1 Provide lateral supports for masonry walls and partitions as required by applicable codes, perpendicular to wall faces and either horizontally or vertically to wall panel edges.

.2 Where lateral support at tops of walls is required, provide anchors or clip angles installed at spacings not exceeding 10 times the wall thickness, unless otherwise indicated.

.3 Where lateral support at sides of walls is required, provide anchors or clip angles installed at spacings not exceeding 4 times the wall thickness, unless otherwise indicated.

3.8 LINTELS

.1 Install steel lintels where indicated.

.2 Provide masonry lintels where shown and where openings of more than 610 mm (24") are shown without structural steel or other supporting lintels.

.3 Provide minimum bearing of 200 mm (8") at each jamb unless otherwise indicated.

3.9 LATERAL SUPPORT AND ANCHORAGE

.1 Unless otherwise indicated, attach strap anchors to building structural members abutting ends of walls. Embed in every second block joint.

.2 Provide other lateral support and anchorage as indicated.

3.10 GROUTING REINFORCED MASONRY

.1 Permit mortar to cure 7 days before placing grout.

.2 Unless otherwise indicated, reinforce masonry unit cores with reinforcing bars and grout as follows:

.1 Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters. Splice reinforcement as indicated.

.2 Wet masonry unit surfaces, in contact with grout just prior to grout placement, when required, to reduce moisture suction from grout.

.3 Grout spaces less than 50 mm (2") in width with Fine grout using low lift grouting techniques. Grout spaces 50 mm (2") or greater in width with Coarse grout using high or low lift grouting techniques. Completely fill spaces of stack bonded masonry; attain minimum 50 percent grout filling of spaces in running bond masonry.

.4 When grouting is stopped for more than one hour, terminate grout 38 mm below top of upper masonry unit to form a positive key for subsequent grout placement.

.3 Low Lift Grouting: Place first lift of grout to a height of 400 mm (16") to three masonry unit courses and rod for grout consolidation. Place subsequent lifts in 200 mm (8") increments and rod for grout consolidation.

.4 High Lift Grouting:

.1 Provide cleanout opening no less than 100 mm (4") high at the bottom of each cell to be grouted by cutting one face shell of masonry unit.

.2 Clean out masonry cells with high pressure water spray. Permit complete water drainage.

.3 Request inspection of cells. Allow 3 days advance notice of inspection.

.4 After cleaning and cell inspection, seal openings with masonry units.

.5 Pump grout into spaces. Maintain water content in grout to intended slump without aggregate segregation.

.6 Limit grout lift to 1500 mm (5') and mechanically vibrate. Wait 45 minutes before placing next lift.

3.11 CONTROL JOINTS

.1 Provide continuous control joints as indicated.

.2 Do not continue horizontal joint reinforcement through control joints, unless otherwise indicated.

.3 Break vertical mortar bond with control joint filler, full depth of unit. Fill adjacent core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

.4 Size control joint as specified in Division 07 Section Sealants, for sealant performance.

.5 Where joint locations are not indicated, space joints 6 m (20') on centre, and one adjacent to corner at each change of direction.

3.12 BUILT-IN WORK

.1 As work progresses, install built-in items to be built into the work and furnished by other sections.

.2 Install built-in items plumb and level.

.3 Build chases; cutting not permitted. When openings require cutting after walls are in place, saw cut only; breaking of block not permitted.

.4 Where masonry encloses conduit or piping, place to required level to permit inspection and testing. Cover items when directed.

.5 Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill hollow metal door frame voids solid with grout or insulation as indicated.

.6 Do not build in organic materials subject to deterioration.

3.13 ERECTION TOLERANCES

.1 Maximum Variation from Plane of Wall: 6 mm/3 m (1/4" per 10') and 13 mm/6 m (1/2" per 20') or more; 3 mm/3m (1/8" per 10') for walls to receive thin-set tile.

.2 Maximum Variation from Plumb: 6 mm (1/4") per story non-cumulative; 13 mm (1/2") in two stories or more.

.3 Maximum Variation from Level Coursing: 3 mm/m (1/8" per 36") and 6 mm/3 m (1/4" per 120").

3.14 CUTTING AND FITTING

.1 Cut and fit neatly for conduit, sleeves, recessed or built-in objects. Coordinate with other sections of work to provide correct size, shape, and location.

.2 Make cuts straight, clean and free of uneven edges.

.3 Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.15 SITE QUALITY CONTROL

.1 Inspections:

.1 Engage a professional structural engineer experienced in design and installation of this work and licensed in the Province where the Project is located, to perform inspections.

.2 Perform timely and regular inspections.

.3 Verify installation conforms to applicable building Code.

.4 Prepare and submit inspection forms required by applicable building code.

.2 Testing:

.1 The City will engage qualified independent testing agency to inspect and test engineered masonry work and prepare reports.

.2 Allow testing agency access to scaffolding and work areas as needed to perform tests and inspections. Retest materials that fail to meet specified requirements.

.3 Tests Prior to Construction: One set of tests.

.4 Tests During Construction: One set of tests for each 300 sq. m (3300 sq.ft.) of wall area or portion thereof.

.5 Mortar and Grout Compressive Strength and Air Content Tests: For each mix provided, according to ASTM C780 for mortar; ASTM C1019 for grout.

3.16 CLEANING

.1 Clean installed work.

.2 Remove excess mortar and mortar smears as work progresses.

.3 Replace defective mortar. Match adjacent work.

.4 Clean soiled surfaces with cleaning solution.

.5 Use non-metallic tools in cleaning operations.

3.17 PROTECTION OF FINISHED WORK

.1 Protect installed work.

.2 Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

.3 Cover unfinished walls to prevent moisture infiltration.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 05 21 00 Steel Joist Framing

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM):

.1 ASTM A36/A36M-19, Standard Specification for Carbon Structural Steel

.2 ASTM A193/A193M-20, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications

.3 ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

.4 ASTM A325-07a, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

.5 ASTM A325M-08, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength

.6 ASTM A490M-04ae, Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-85.10-99, Protective Coatings for Metals

.3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA):

.1 Handbook of the Canadian Institute of Steel Construction

.2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel

.4 CSA Group (CSA):

.1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

.2 CAN/CSA-G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles

.3 CAN/CSA-S16-19, Limit States Design of Steel Structures

.4 CAN/CSA-S136-16, North American Specifications for the Design of Cold Formed Steel Structural Members

.5 CSA W47.1:19, Certification of Companies for Fusion Welding of Steel

.6 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding

.7 CSA W55.3-08, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings

.8 CSA W59-18, Welded Steel Construction (Metal Arc Welding)

.5 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International:

.1 NACE No. 3/SSPC SP-6-07, Commercial Blast Cleaning

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba, Canada.

.3 Erection drawings:

.1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:

.1 Description of methods.

.2 Sequence of erection.

.3 Type of equipment used in erection.

.4 Temporary bracings.

.4 Fabrication drawings:

.1 Submit fabrication drawings showing designed assemblies, components and connections stamped and signed by qualified professional engineer licensed in the Province of Manitoba, Canada.

.2 Submit connection design calculations stamped and signed by qualified professional engineer licensed in the Province of Manitoba, Canada.

.5 Source Quality Control Submittals:

.1 Submit 1 copies of mill test reports 4 weeks before fabrication of structural steel.

.1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.

.2 Provide mill test reports certified by metallurgists qualified to practise in Canada.

.6 Fabricator Reports:

.1 Provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

.7 Inspection Reports:

.1 Submit inspection and test reports prepared by an independent inspect and test agency retained by the contractor.

1.4 QUALITY ASSURANCE

.1 Contractor shall retain a Professional Engineer, licensed in the Province of the Project, with minimum 5 years of experience in design, fabrication and erection of structural steel Work of comparable complexity and scope, to perform the following services as part of the Work of this Section:

.1 Design of structural members and connections.

.2 Stamp and sign Shop Drawings, design calculations and amendments.

.3 Review and report on structural steel fabricator’s quality control tests and reports for compliance with the Contract Documents.

.4 Review inspection and test reports by independent inspection agency.

.5 Conduct minimum of (3) fabrication shop reviews during steel fabrication and monthly site reviews during structural steel erection. Prepare and submit written reports verifying that the Work is in accordance with the Contract Documents and reviewed Shop Drawings.

.2 Contractor shall retain an independent inspection and test agency to perform testing and inspections in accordance with CAN/CSA S16 and CSA W59.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirement.

.2 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.

2 Products

2.1 DESIGN REQUIREMENTS

.1 Design details and connections in accordance with requirements of CAN/CSA-S16 to resist forces, moments, shears and allow for movements indicated.

.2 Shear connections:

.1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.

.2 Select or design connections to support reaction from maximum uniformly distributed load (max UDL) that can be safely supported by beam in bending, provided no point loads act on beam, when shear loads are not indicated on design drawings. Such maximum uniformly distributed load (max UDL) shall be determined with the assumption that the compression of the beam flange is laterally supported fully.

.3 Coordinate with steel joist and joist girder subcontractors to design connections to support open web steel joists and joist girders.

.1 At all structural steel beams that support joists, adjust steel beam elevations to accommodate varying depths of joist shoes. Joist shoe depths must be verified with joist suppliers.

.2 At all structural steel columns that directly support joists above, adjust top of steel column elevations to accommodate varying depths of joist shoes. Joist shoe depths must be verified with joist suppliers. Provide minimum 8mm cap plate.

.3 At all structural steel columns that support joists girders, adjust top of steel column elevations to accommodate depths of joist girder shoes, or provide supporting brackets at side face of columns to support joist girders.

.4 Joist girders are to be connected to columns with rigid end moments that consist of concentrated forces at top and bottom chords of the joist girder. Coordinate with joist girder supplier and provide supporting cap plates, brackets and connection plates at joist girder’s top and bottom chords. Design local stiffeners in columns for the concentrated loads from joist girders, as required.

.4 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of Manitoba, Canada for non-standard connections, bracing connections, moment connections, joist girder connections, amd hanger connections.

2.2 MATERIALS

.1 Structural Steel: To CSA-G40.20/G40.21 Grade 350W.

.2 Anchor Bolts: To CSA-G40.20/G40.21, Grade 300.

.3 Bolts, nuts and washers: to ASTM A325.

.4 Welding Materials: To CSA W59 and certified by Canadian Welding Bureau.

.5 Shop Paint Primer: To CISC/CPMA2-75 solvent reducible alkyd red oxide.

.6 Hot Dip Galvanizing: Galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m^2.

.7 All structural steel, including anchor rods, and connection bolts, in the Vehicle Wash areas, Under-vehicle Cleaning Areas and the Vehicle Repair Wet Bay areas shall be hot dip galvanized.

.8 Shear Studs: To CSA W59, Appendix H

2.3 FABRICATION

.1 Fabricate structural steel in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings].

.2 Continuously seal members by continuous welds where indicated.

2.4 SHOP PAINTING

.1 Clean, prepare surfaces, and shop prime structural steel in accordance with CSA S16.

.2 Clean members, remove loose mill scale, rust, oil, dirt and foreign matter. Prepare surface according to NACE No.3/SSPC-SP-6.

.3 Apply one coat of primer in shop to steel surfaces to achieve minimum dry film thickness of 1.5 to 2.0 mils, except:

.1 Surfaces to be encased in concrete.

.2 Surfaces to receive site installed stud shear connections.

.3 Surfaces and edges to be site welded.

.4 Faying surfaces of slip-critical connections.

.4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.

.5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.

.6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

.7 All structural steel, including connection bolts in humid and corrosive areas shall be hot dip galvanized. Refer to architectural and industrial drawings for such areas.

3 Execution

3.1 GENERAL

.1 Structural Steel Work: In accordance with CAN/CSA-S16.

.2 Welding: in accordance with CSA W59.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components

3.2 MARKING

.1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection

.2 Match marking: shop mark bearing assemblies and splices for fit and match.

3.3 ERECTION

.1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16 and in accordance with reviewed erection drawings].

.2 Site cutting or altering structural members: to approval of Contract Administrator.

.3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.

.4 Continuously seal members by continuous welds where indicated. Grind smooth.

3.4 SITE QUALITY CONTROL

.1 Contractor shall retain an independent testing/inspection agency to perform the following inspection and testing in accordance with CAN/CSA S16 and CSA W59:

.1 Steel erection conformance to reviewed shop drawings.

.2 Marking identification and conformance to CSA standards.

.3 Alignment of bolt holes.

.4 Visual inspection of shop and field welding.

.5 Placement, type, and thickness of hardened washers.

.6 Test shear studs in accordance with CSA W59.

.2 Provide safe access and working areas for testing on site, as required by inspecting and testing.

.3 Submit test reports to Contract Administrator within 2 weeks of completion of inspection.

3.5 SITE PAINTING

.1 Paint in accordance with Section 09 90 00 – Painting.

.1 Touch-up damaged surfaces and surfaces without shop coat with primer to NACE No.3/SSPC-SP-6 except as specified otherwise.

3.6 CLEANING

.1 Clean in accordance with Section 01 74 00 – Cleaning.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Steel Joists and Joist Girders.

1.2 RELATED REQUIREMENTS

.1 Section 05 12 23 – Structural Steel for Buildings.

.2 Section 09 90 00 – Painting

1.3 DEFINITIONS

.1 Application Specialist: An individual who performs surface preparation and application of protective coatings and linings to steel and concrete surfaces of complex industrial structures.

1.4 REFERENCE STANDARDS

.1 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA):

.1 CISC/CPMA 2-75, Quick-Drying, Primer for Use on Structural Steel

.2 CISC/CPMA 1-73a, Quick-Drying, One-Coat Paint for Use on Structural Steel

.2 CSA Group (CSA):

.1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

.2 CSA S16-19, Design of Steel Structures

.3 CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members

.4 CSA W47.1-19, Certification of Companies for Fusion Welding of Steel

.5 CSA W55.3-08-, Certificate of Companies for Resistance Welding of Steel and Aluminum

.6 CSA W59-18, Welded Steel Construction (Metal Arc Welding)

.3 NACE International:

.1 ANSI/NACE No. 13/SSPC-ACS-1 Industrial Coating and Lining Application Specialist Qualification and Certification

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for steel joist framing and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer licensed in Manitoba, Canada.

.2 Indicate on erection drawings, relevant details such as mark, depth, spacing, bridging lines, bearing, anchorage and details for joists and joist girders.

.3 Indicate particulars, on shop drawings, relative to joist and joist girder geometry, framed openings, splicing details, bearing and anchorage. Include member size, properties, specified and factored member loads, and stresses under various loadings, deflection and camber.

.4 At all joist girders' end moment connections, provide connection details and factored forces.

.4 Delegated Design Submittals:

.1 Submit calculations and joist design drawings for all joists and joist girders, stamped by a professional engineer licensed in Manotiba, to Contract Administrator for review minimum 4 weeks before fabrication and delivery.

1.6 QUALITY ASSURANCE

.1 Submit copies of mill test reports minimum 4 weeks before fabrication of steel joists and accessories. Reports to show:

.1 Chemical and physical properties.

.2 Other details of steel incorporated into work.

.3 Certification by qualified metallurgists confirming that tests conform to requirements of CSA G40.20/G40.21

.2 Submit affidavit prepared by fabricator of structural steel joists and joist girders stating materials and products used in fabrication conform to this specification.

.3 Retain a Professional Engineer, licensed in the Province of Manitoba, with minimum 5 years of experience in steel joists and joist girders of comparable complexity and scope, to perform the following services as part of the Work of this Section:

.1 Design steel joist and joist girder members and connections.

.2 Review, stamp, and sign fabrication and erection drawings, design calculations, and amendments thereto.

.3 Conduct minimum (5) on-site inspections during joist and joist girder installation, and prepare and submit inspection reports verifying this part of the Work is in accordance with the Contract Documents and reviewed Shop Drawings.

.4 Upon completion of work, certify the work has been completed in accordance with the Contract Documents and reviewed Shop Drawings; stamp as built drawings; issue Certificate of Conformance.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

1.8 SITE CONDITIONS

.1 Verify dimensions and condition of existing work; report discrepancies and potential problem areas to Contract Administrator for direction before commencing fabrication.

2 Products

2.1 DESIGN CRITERIA

.1 Design steel joists and joist girders to carry loads indicated on drawings to CSA S16.

.2 Design joists, joist girders and anchorages for uplift forces as indicated.

.3 Manufacture joists and joist girders to consider load effects due to fabrication, erection and handling.

.4 Limit roof joist / joist girder deflection due to specified live or snow load to 1/360 of span, and limit deflection due to total specified load to 1/240 of span.

.5 Limit floor joist deflection due to specified live load to 1/360 of maximum span, and limit deflection due to total specified load to 1/240 of span.

.6 Design joist girders for end moments as indicated on design drawings. End moment connections shall be provided at each end of joist girders so that the joist girder is part of the lateral load resisting frame of the building. Joist girders' end moment connections shall be completed (fixed) after all dead loads of the building have been applied.

.7 At joist girders' end moment connections, provide factored forces and details of the joist girder's top and bottom chords to structural steel fabricator for connection design coordination purposes.

.8 Coordinate with structural steel supplier for the connection details and support details at joist shoes, joist girders' end moment connections, bridgings, and accessories.

.9 For multiple adjacent joists or joist girders that are parallel to one another in the same structural bay, their web members shall be arranged in the same consistent pattern.

.10 In combination with applicable design loads shown on Contract Drawings, design all roof joists for an additional concentrated live load of 4.0kN at any panel point along the bottom chord of the joist, unless otherwise noted on Contract drawings.

.11 Design joists to support concentrated loads from roof top units, roof anchors, roof ladders, stairs and similar roof-top accessories. Coordinate quantity and location of such loads with reviewed shop drawings of the corresponding supplier(s).

2.2 MATERIALS

.1 Open web steel joists and joist girders: to CSA S16.

.2 Structural steel: to CSA G40.20/G40.21.

.3 Welding materials: to CSA W59

.4 Shop paint primer: to CISC/CPMA-2.

.5 Shear studs: to CSA W59, Appendix H

2.3 FABRICATION

.1 Prior to fabrication, coordinate with structural steel supplier to confirm all joist shoe connections, joist girder's end connections and associated details.

.2 Fabricate steel joists, joist girders and accessories as indicated in accordance with CSA S16 and in accordance with reviewed shop drawings.

.3 Weld in accordance with CSA W59.

.4 Provide top and bottom chord extensions where indicated.

.5 Provide diagonal and horizontal bridgings and anchorages as indicated.

.6 Camber all joists and joist girders equal to dead load deflection.

.7 Weld studs to top chords for attachment purposes.

.8 Install shear studs in accordance with CSA W59.

2.4 SHOP PAINTING

.1 Clean, prepare and shop prime surfaces of steel joists to SSPC SP6.

.2 Clean members of loose mill scale, rust, oil, dirt and other foreign matter. Prepare surfaces to SSPC SP1 brush blast.

.3 Apply one coat of CISC/CPMA 2 primer to steel surfaces to achieve dry film thickness of .065 mm to .080 mm maximum except:

.1 Surfaces encased in concrete.

.2 Surfaces to receive site installed stud shear connectors and steel decks.

.3 Surfaces and edges site welded.

.4 Faying surfaces of friction-type connections.

.5 Below grade surfaces in contact with soil.

.4 Apply paint under cover, on dry surfaces when surface and air temperatures minimum 5 degrees C.

.5 Maintain dry condition and 5 degrees C minimum temperature until paint thoroughly dry.

.6 Strip paint bolts, nuts, sharp edges and corners before prime coat drys.

.7 All joists, joist girders, bridgings, connecting hardware and accessories in humid and corrosive areas shall be hot dip galvanized. Refer to architectural and industrial drawings for such areas.

3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for steel joist framing installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

3.2 ERECTION

.1 Do structural steel work: to CSA S16.

.2 Do welding: in accordance with CSA W59

.3 Ensure installers certified to CSA W47.1 for fusion welding or CSA W55.3 for resistance welding

.4 Submit certification welded joints qualified by Canadian Welding Bureau.

.5 Erect steel joists, joist girders and bridging as indicated to CSA S16 and in accordance with reviewed erection drawings.

.6 Complete installation of bridging and anchorages before placing construction loads on joists.

.7 Complete installation of joist girders' end moment connections after all dead loads on the structure is applied.

.8 Site cutting or altering joists or bridging: to approval of Contract Administrator.

.9 Clean and touch up shop primer to bolts, welds, burned or scratched surfaces at completion of erection.

3.3 SITE QUALITY CONTROL

.1 Inspection and testing of materials and work carried out by testing laboratory designated by Contract Administrator.

.2 Testing laboratory to inspect representative joists for integrity, accuracy of fabrication and soundness of welds. Testing laboratory to also monitor test loading of joists used by manufacturer to verify design and check representative site connections. Contract Administrator will determine extent of and identify inspections.

.3 Submit test report to Contract Administrator within 5 days after completion of inspection.

.4 Test shear studs to CSA W59.

3.4 SITE PAINTING

.1 Paint: in accordance with Section 09 90 00 – Painting.

.2 Touch up damaged surfaces and surfaces without shop coat with CISC/CPMA-2 in accordance with manufacturers' recommendations.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by steel joist framing installation.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 05 12 23 – Structural Steel For Buildings.

.2 Section 05 21 00 – Steel Joist and Joist Girder Framing

.3 Section 09 90 00 –Painting

1.2 DEFINITIONS

.1 Application Specialist: An individual who performs surface preparation and application of protective coatings and linings to steel and concrete surfaces of complex industrial structures.

1.3 REFERENCE STANDARDS

.1 ASTM International (ASTM):

.1 ASTM A653/A653M-15e, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.2 ASTM A780-01 Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings

.3 ASTM A792/A792M-10 (2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

.2 Canadian Sheet Steel Building Institute (CSSBI):

.1 CSSBI 10M-13, Standard for Steel Roof Deck

.2 CSSBI 12M-15, Standard for Composite Steel Deck

.3 CSA Group (CSA):

.1 CSA C22.2 No.79-2016, Cellular Metal and Cellular Concrete Floor Raceways and Fittings

.2 CSA S16-19, Design of Steel Structures

.3 CSA S136-12, North American Specification for the Design of Cold Formed Steel Structural Members including Update No. 1 (2014), Update No. 2. (2014), Update No. 3 (2015)

.4 CSA W47.1-19, Certification of Companies for Fusion Welding of Steel Structures

.5 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum

.6 CSA W59-18, Welded Steel Construction, (Metal Arc Welding)

.4 Canadian Steet Steel Building Institute (CSSBI):

.1 CSSBI 10M-13, Standard for Steel Roof Deck

.2 CSSBI 12M-15, Standard for Composite Steel Deck

.3 ANSI/NACE No. 13/SSPC-ACS-1-2016 -SG, Industrial Coating and Lining Application Specialist Qualification and Certification.

1.4 DESIGN REQUIREMENTS

.1 Design steel deck to CSA S136 and CSSBI 10M.

.2 Design roof and floor composite steel deck to CSA S16, CSA S136, and CSSBI 12M.

.3 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action, composite deck action, and uplift as indicated.

.4 Deflection under specified live or snow load maximum 1/360 of span.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for steel decking and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS SDS in accordance with Section 01 35 29.06 – Health and Safety Requirements 01 35 43 – Environmental Procedures.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer licensed in Manitoba.

.2 Submit design calculations if requested by Contract Administrator.

.3 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.

.4 Indicate details of temporary shoring of steel deck, such as location, time and duration of placement and removal of shoring for concrete fill decks.

.4 Certificates:

.1 Submit certifications for Application Specialists to demonstrate compliance to the requirements of ANSI/NACE No.13.

1.6 QUALITY ASSURANCE

.1 Retain professional engineer licensed in Manitoba, with experience in steel deck Work of comparable complexity and scope, to perform following services as part of Work of this Section:

.1 Structural design of steel deck and composite deck.

.2 Review, stamp, and sign Shop, shoring and erection Drawings, design calculations, and revisions required.

.3 Conduct on-site inspections and prepare and submit inspection reports verifying this part of Work in accordance with Contract Documents and reviewed Shop Drawings. Perform inspections minimum of once per month.

.4 Monitor supplier's and fabricator's quality control tests and reports.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry condition and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect decking from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 Products

2.1 MATERIALS

.1 Zinc-iron Alloy (ZF) coated steel sheet: to ASTM A653/A653M structural quality Grade 230, with ZF75 coating, for interior surfaces not exposed to weather or humid / corrosive area, 0.76 mm minimum base steel thickness.

.2 Decks to be painted: zinc-iron alloy coated decks suitable for finish painting.

.3 Zinc (Z) coated steel sheet: to ASTM A653/A653M structural quality Grade 230, with ZF275 galvanized coating, for surfaces exposed to weather or humid / corrosive area, 0.76 mm minimum base steel thickness.

.4 Closures: as indicated in accordance with manufacturer's recommendations.

.5 Cover plates, cell closures and flashings: steel sheet with minimum base steel thickness of 0.76 mm minimum. Metallic coating same as deck material.

.6 Primer: to section 09 90 00 – Painting.

.7 Caulking: to Section 07 92 00 – Joint Sealants.

.8 Shear studs: to CSA W59.

2.2 TYPES OF DECKING

.1 Steel roof deck: 0.76 mm minimum base steel thickness, 38 mm maximum deep profile, non-cellular, interlocking side laps.

.2 Composite steel roof deck: 0.76 mm minimum base steel thickness, 38mm deep profile, non-cellular embossed fluted profile, interlocking side laps.

3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for steel decking installation in accordance with manufacturer's written instructions.

.1 Inform Contract Administrator of unacceptable conditions immediately upon discovery.

.2 Proceed with installation after unacceptable conditions remedied

3.2 PREPARATION

.1 Locate bundles of deck materials to prevent overloading of supporting members.

.2 Install temporary shoring before placing deck panels, if required to meet deflection limitations.

3.3 ERECTION

.1 Structural steel work: in accordance with CSA S136 and CSSBI 10M and CSSBI 12M.

.2 Welding: in accordance with CSA W59, except where specified otherwise

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel or CSA W55.3 for resistance welding

.4 Erect steel deck as indicated and in accordance with CSA S136 and CSSBI 10M and CSSBI 12M and in accordance with reviewed erection drawings.

.5 Lap ends: to 50 mm minimum.

.6 Weld and test stud shear connectors through steel deck to steel joists/beams below in accordance with CSA W59

.7 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.

.8 Before concrete placement, steel deck free of soil, debris, standing water, loose mil scale and other foreign matter.

.9 Temporary shoring, if required, designed to support construction loads, wet concrete and other construction equipment. Do not remove temporary shoring until concrete attains 75% of its specified 28 day compression strength.

.10 Place and support reinforcing steel as indicated.

.11 Closures: Install closures in accordance with approved details.

.12 Openings and Areas of Concentrated Loads

.1 No reinforcement required for openings cut in deck maximum 150 mm square except for group openings noted below.

.2 Frame deck openings with any one dimension between 150 to 450mm as recommended by manufacturer, except as otherwise indicated. Reinforcing angles for such opening shall not be less than L51x51x6 on all 4 sides of the opening; reinforcing angles perpendicular to deck flutes shall be extended minimum 2 flutes beyond the opening.

.3 For deck openings with any one dimension greater than 450mm and for areas of concentrated load, reinforce in accordance with structural framing details, except as otherwise indicated.

.4 Group openings: Where 2 or more openings (regardless of the opening size) are located adjacent to each other in such way that the clear dimension between edges of any 2 adjacent openings is less than 1.5 times the smaller size of the 2 openings, reinforcing the openings as if these openings construct one continuous opening across the deck. Alternatively, reinforcing shall be based on design analysis by the steel deck supplier's engineer.

3.4 CONNECTIONS

.1 Install connections in accordance with CSSBI recommendations as indicated

3.5 SITE TOUCH-UP PAINTING

.1 Upon erection completion, mechanically brush clean bolts, rivets, welds, and burned or scratched surfaces.

.2 For galvanized steel surface with damage and without shop coat, repair with site touch up primer.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by steel decking installation.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Unless otherwise specified conform to CSA-S16, Steel Structures for Building - Limit States Design and CAN/CSA-S136, Cold Formed Steel Structural Members.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 Canadian Institute of Steel Construction (CISC):

.1 CISI - Specification for the Design of ColdFormed Steel Structural Members, in accordance with CAN/CSA-S136.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A153/A123M, Zinc Coating (Hot-Dipped) on Iron and Steel Hardware.

.2 ASTM A568/A568M, General Requirements for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

.3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.4 ASTM C955, Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging for Screw Application of Gypsum Board and Metal Plaster Bases.

.4 American National Standards Institute/American Welding Society:

.1 ANSI/AWS D1.3, Structural Welding Code - Sheet Steel.

.5 Canadian Standards Association:

.1 CSA-W47.1, Certification of Companies for Fusion Welding of Steel Structures.

.2 CSA-W59, Welded Steel Construction (Metal Arc Welding).

.3 CSA-S16, Design of Steel Structures

.4 CAN/CSA-S136, North American Specification for the Design of Cold-Formed Steel Structural Members

.6 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating

.2 CAN/CGSB-51.32, Sheathing, Membrane, Breather Type

.7 Canadian Sheet Steel Building Institute:

.1 CSSBI 51M, Lightweight Steel Framing Design Manual.

1.4 DESIGN CRITERIA

.1 The following metal stud framing are to be designed, supplied and installed as part of this section:

.1 Metal studs receiving loads from exterior cladding and glazing.

.2 Metal stud framing indicated as engineered metal studs.

.3 Where light gauge metal stud framing exceeding prescriptive span and loading capabilities of Section 09 21 00 - Gypsum and Cement Board Assemblies.

.2 Unless otherwise specified conform to CAN/CSA S16.1, Steel Structures for Building - Limit States Design and CAN/CSA S136, Cold Formed Steel Structural Members.

.3 Have work of this section designed by a professional engineer licensed to design structures and registered in the place of Work.

.4 Calculate loads and load factors in accordance with the Building Code.

.5 External Walls: Design for simultaneous exterior and interior wind pressure in accordance with NBCC2020. Interior wind pressure coefficient (Cpi) shall be -0.70 to +0.70, except that the interior wind pressure coefficient (Cpi) for the administration area shall be -0.45 to +0.30.

.6 Internal Walls: Design all interior walls for an unbalanced wind pressure of 0.75kPa, except that the unbalanced wind pressure in the administration area shall be 0.48kPa.

.7 Base design on Limit States Design principles using factored loads and resistances.

.8 Determine resistances and resistance factors in accordance with the Building Code and CSA S136.

.9 Select studs which will deflect under specified lateral loads not more than L/360.

.10 Determine resistance strength and resistance factors in accordance with applicable building code requirements and CAN/CSA S136.

.11 Construct work of this section to provide for expansion and contraction of components as will be caused by ambient temperature range without causing buckling, failure of joint seals, undue stress on fasteners or other effects detrimental to appearance or performance.

.12 Compute section properties on the basis of the nominal core thickness.

.13 Design bridging to prevent member rotation and member translation perpendicular to the minor axis. Provide for secondary stress affects due to torsion between lines bridging. Sheathing shall not be used to help restrain member rotation and translation perpendicular to the minor axis for wind bearing studs.

.14 Design cold formed metal framing system to support loads and superimposed loads transferred from cladding and include for design of support and attachment components between other assemblies and stud system. Responsibility for design of exterior wall loads transferred from other envelope components is part of work of this section.

1.5 SUBMITTALS

.1 Shop Drawings:

.1 Prepare and submit shop and erection drawings which conform to the requirements of the CAN/CSA-S16, and as specified herein.

.2 Cold formed metal framing system must have shop drawings prepared by qualified draftsmen, checked by and bearing the seal of a professional engineer registered to design structures and practice in the place of Work.

.3 Show the size, spacing and location of connections, attachments, reinforcing and anchorage. Include necessary plans, elevations and details. Indicate size and type of fastening. For weld connections use welding symbols in compliance with AWS and indicate clearly net weld lengths.

.4 Submit typical details of connections, and any special connections for approval before preparation of shop drawings.

.5 Review of shop drawings by the Contract Administrator will not absolve the Contractor from his responsibility of providing materials and equipment to complete and finish work of this section in accordance with the architectural and structural drawings. Departures or differences from the referenced drawings shall be approved in writing by the Contract Administrator.

.2 Sustainable Design Submittals:

.1 LEED Submittals: submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Documentation identifying quantity by weight of recycled content in steel product if content is over 25% and to be claimed as such toward LEED credits.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20% of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project.

.3 Submit product data for site applied touch-up primer verifying compliance with GC-03, Green Seal Environmental Criteria for Anti-Corrosive Paints, for VOC content.

1.6 QUALITY ASSURANCE

.1 Conform to requirements of CAN/CSA-S16, Steel Structures for Buildings, and CAN/CSA-S136, Cold Formed Steel Structural Members.

.2 Work to be executed by firm thoroughly conversant with laws, by-laws and regulations which govern, and capable of workmanship of best grade of modern shop and field practice known to recognized manufacturer's specializing in this work.

.3 Work shall be executed by workers especially trained and experienced in this type of work. Have a full time, senior, qualified representative at the site to direct the work.

.4 Install system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.

.5 Install system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.7 INSPECTION AND TESTING

.1 An independent inspection and testing company appointed and paid for by the City may carry out inspection and testing of the structural steel stud systems.

.2 Provide free access for inspectors to all places where work is being done.

.3 Inspectors are to ensure that materials conform to the requirements of this section.

.4 Any inspection and/or testing required because of an error by the Contractor, or due to departure from the Contract Documents shall be paid for by the Contractor.

.5 Inspection and testing of structural metal stud systems shall include, but shall not be limited to the following:

.1 Checking that mill test reports are properly correlated to materials.

.2 Sampling fabrication and erection procedures for general conformity to the requirements of the specification.

.3 Checking that the welding conforms to the requirements of CSA W47.1, CSA W59 and/or ANSI/AWS D1.3, whichever is applicable.

.4 Checking fabricated members against specified member shapes.

.5 Visual inspection of all welded connections including sample checking of joint preparation and fit-up.

.6 Sample checking of screwed and bolted joints.

.7 Sample checking that tolerances are not exceeded during fit-up and/or erection.

.8 Additional inspection and testing of welded connections at required by CSA W59.

.9 General inspection of field cutting and alterations required by other trades.

.10 Submission of reports to the Contract Administrator covering the work inspected with details of deficiencies discovered.

.6 The inspection and testing provided in this Section does not relieve the Contractor of his responsibility for the performance of the Contract. The Contractor shall implement his own supervisory and quality control procedures.

.7 Materials and/or workmanship not conforming to the requirements of the Contract Documents may be rejected at any time during the progress of the work, and shall be replaced and/or repaired without cost to the City.

1.8 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with Construction Progress Schedule and arrange ahead for off-the-ground storage location. Do not load any area beyond the design limits.

.2 Adequately protect steel against rust and damage during manufacturing, delivery and storage.

.3 Store material on planks on a dry area and protect from damage. Make good immediately any damage done, clean scratches and the like, touch-up with specified primer.

2 Products

2.1 MANUFACTURERS

.1 Cold formed metal framing as indicated on drawings and as specified herein shall be by one of the following:

.1 Bailey Metal Products Limited.

.2 Canadian Steel Manufacturing, Division of British Steel Canada Inc.

.3 Lightsteel Inc., Boucherville, Quebec.

.4 Or approved alternate.

2.2 MATERIALS

.1 Faming materials shall conform to the requirements of CAN/CSA-S136.

.2 Galvanized Sheet Steel:

.1 Conform to ASTM A653/A653M, minimum Grade D, 50 PSI (345 Mpa) yield for 1.5mm (.060") material.

.3 Structural Metal Studs:

.1 Galvanized sheet steel formed to channel shape, of minimum gauge, sizes, and section properties to meet design requirements, and conforms to ASTM C955.

.4 Metal Stud Runners/Top and Bottom Tracks:

.1 Galvanized sheet steel formed to channel shape, having same width as studs, with tight fit and solid web, of minimum gauge to meet design requirements, but no less than gauge of metal studs, and conforms to ASTM C955.

.5 Metal Plates, Bridging, Gussets and Clips:

.1 Formed from galvanized sheet steel, of gauges, shapes and sizes required to meet design requirements determined for conditions encountered, and of same finish as framing members.

.6 Fastenings:

.1 Self drilling, Self tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized to 1.25 ounce per square foot and conforms to ASTM A153/A153M-09, Class B3. 12-24 x 7/8 HWH #4STLG by Hilti Canada, or approved alternate.

.2 Anchorage Devices: Power driven, powder actuated, drilled expansion bolts, or screws with sleeves, as application dictates.

.3 Welding Materials: Conforms to CSA W59.

.4 Electrodes for welding shall have minimum 480 Mpa tensile strength series, (E480XXX,E480S-X).

.7 Touch-Up Primer:

.1 Ready mixed, zinc-rich primer, and conforms to CAN/CGSB-1.181, Zinc Clad No.5 Organic Zinc Rich Primer by Sherwin Williams Company of Canada Ltd., or approved alternate.

.8 Bituminous Paint: Acid and alkali resistant bituminous isolation coating.

.9 Butyl Tape: Extruded, High grade macro-polyisobutylene tape of width and shore hardness to suit conditions.

.10 Dampproof Course: No.15 asphalt saturated, organic felt in accordance with CSA A123.3.

2.3 FABRICATION

.1 Fit and assemble work in shop where possible. Execute work according to details and reviewed shop drawings.

.2 Take measurements at the building for work which is to fit or be connected to steel, concrete framing or masonry, before commencing fabrication.

.3 Structural metal studs shall have one unreinforced service cut-out centred in the web of the studs and with the centreline of the cut-out a minimum of 455 mm (1'-6") from the bottom of the studs. In addition to the above, provide cut-outs for internal bridging as required. All unreinforced cut-outs shall conform to dimension limitations of Table 1, in the CSSBI M50-1987 Manual.

.4 Provide prepunched cut-outs in inner top track for anchor clearances so that deflection clearances are not reduced.

.5 Fabrication tolerances for cold formed steel framing members shall to Table 2 of the CSSBI M50 Manual.

.6 Cutting of cold formed steel framing members shall be by "power saw" or "shear" methods. Cutting by "torch" method shall not be permitted.

.7 Steel thickness, exclusive of coating shall be marked on all cold formed steel framing members by embossing, or by stamping with indelible ink, or by colour coding method.

.8 Gauges and sizes of metal shall be adequate for various conditions.

3 Execution

3.1 EXAMINATION

.1 Verify at site that the work to receive the work of this section is free of irregularities detrimental to the installation and performance of the work and that it is located correctly and at proper levels before delivery and installation.

.2 Verify that building framing components are ready to receive work.

.3 Beginning of installation means acceptance of existing conditions.

3.2 ERECTION OF STUDS

.1 Install components in strict accordance with manufacturer's written instructions.

.2 Methods of construction may be either piece by piece (stick-built), or by fabrication into panels (panelized) either on or off site. Handling and lifting of prefabricated panels shall not cause permanent distortion to any member or collateral material.

.3 Cold formed steel framing shall be erected true and plumb within the tolerances specified herein. Temporary bracing shall be employed wherever necessary to withstand all loads to which the structure may be subject during erection and subsequent construction. Temporary bracing shall be left in place as long as required for the safety and integrity of the structure. The Contractor shall ensure that during erection a margin of safety consistent with the requirements of the National Building Code and CAN/CSA-S136 exists in the uncompleted structure.

.4 Erection Tolerances:

.1 For the purposes of erection tolerances, "camber" is defined as the deviation from straightness of a member or any portion of a member with respect to its major axis and "sweep" is defined as the deviation from straightness of a member or any portion of a member with respect to its minor axis.

.2 For wind bearing studs, out of plumbness shall not exceed 1/500th of the member length. Out of straightness (camber and sweep) shall not exceed 1/1000th of the member length.

.3 For runners/tracks, camber shall not exceed 1/1000th of the member length.

.4 Studs shall seat into top and bottom runners/tracks. The gap between the end of the stud and the web of the runner/track shall not exceed 4 mm (5/32") for wind bearing studs.

.5 Where cold formed metal framing is made in prefabricated panels, align adjacent prefabricated panels to provide surface continuity at the interface.

.6 Spacing of studs shall not be more than 3 mm (1/8") from the design spacing. The cumulative error in spacing shall not exceed the requirements of the finishing materials.

.5 Align floor and ceiling runners/tracks, locate to wall or partition layout. Secure in place with screws or welding at maximum 610 mm (24") O.C. Coordinate installation of sealant with floor and ceiling track.

.6 Place studs to meet design requirements as indicated on approved shop drawings, and not more than 50 mm (2") from abutting walls, and at each side of openings. Connect studs to tracks using clips and ties, screws, or welding. Diameter of screws shall be equal to, or exceed the minimum diameter indicated on the reviewed shop drawings. Penetration of screws beyond joined materials shall be not less than three (3) exposed threads. Thread types and drilling capability of screws shall conform to the manufacturer's written recommendations to suit design requirements and conditions. Screws to be covered by sheathing materials shall have "low profile" type heads.

.7 Isolate contact surfaces to prevent electrolysis due to metal contact with masonry, concrete or dissimilar metal surfaces. Use bituminous paint, dampproof paper, butyl tape or other approved means.

.8 Field cutting of cold formed steel framing members shall be by "power saw" or "shear" methods. Cutting by "torch" method shall not be permitted.

.9 Holes that are field cut into cold formed steel framing members shall conform to the dimensional requirements of Table 1, in the CSSBI M50-1987 Manual.

.10 Brace structural metal studs as required to meet design requirements and as indicated on reviewed shop drawings.

.11 Provide continuous dampproof course to underside of bottom runner/track.

.12 Construct corners using minimum of three studs. Double studs at door, window jambs, and wall openings.

.13 Erect studs one piece full length. Splicing of studs is not permitted.

.14 Erect load bearing studs, brace, and reinforce to develop full strength to meet design requirements.

.15 Refer to drawings for height of partition framing.

.16 Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

.17 Install intermediate studs above and below openings to match wall stud spacing.

.18 Provide deflection allowance in stud bottom runner/track, directly below horizontal building framing for nonload bearing framing.

.19 Attach cross studs or furring channels to studs for attachment of fixtures anchored to walls. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

.20 Touch-up field welds and damaged galvanized surfaces with two coats of zinc rich touch-up primer.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 05 12 23 Structural Steel for Buildings

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM):

.1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM A307-21, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

.3 ASTM A653/A653M-18, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.4 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

.5 ASTM F3125/F3125M-22, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.181-99, Ready—Mixed Organic Zinc—Rich Coating

.3 CSA Group (CSA):

.1 CSA W47.1:19, Certification of Companies for Fusion Welding of Steel

.2 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum

.3 CSA W59-18, Welded Steel Construction

.4 CSA S136-, North American Specification for the Design of Cold-Formed Steel Structural Members

.5 CSA S304-14,Design of masonry structures

.4 Canadian Sheet Steel Building Institute (CSSBI):

.1 CSSBI 51-06, Lightweight Steel Framing Design Manual

.2 CSSBI Technical Bulletin Vol. 7, No. 2 September 2011, Standard Thicknesses for Canadian Lightweight Steel Framing Applications

.5 National Research Council of Canada (NRC):

.1 National Building Code of Canada (NBC), 2020

.6 The Master Painters Institute (MPI):

.1 Architectural Painting Specification Manual,

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, product literature, and data sheets for structural metal stud framing. Include product characteristics, performance criteria, physical sizes, metallic coatings, and limitations.

.2 Submit Workplace Hazardous Materials Information System (WHMIS), Safety Data Sheets (SDS).

.3 Shop Drawings: Submit shop drawings prepared by the delegated design engineer bearing their stamp and signature of a professional engineer licensed in Manitoba.

.1 Indicate design loads, member sizes, materials, design thickness exclusive of coatings, coating specifications, connection and bracing details, screw sizes and spacing, and anchors.

.2 Indicate member and connection locations, dimensions, openings, and connections related work.

.3 Include erection diagrams and critical installation procedures as required.

.4 Indicate welds with welding symbols as defined in CSA W59.

.4 Samples: When requested, submit 300 mm lengths of samples of framing components for review.

.5 Site Quality Control Submittals: Submit delegated design engineer’s reports, as described in SITE QUALITY CONTROL in Part 3 of this Section.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Welders: Companies certified to CSA W47.1 for fusion welding and CSA W55.3 for resistance welding.

.2 Licensed Professional: Delegated design engineer, licensed professional engineer in Manitoba of the Work, who is not the Contract Administrator.

.2 Test Reports: When requested, submit certified test reports showing compliance with specified performance characteristics and physical properties.

.3 Certificates: When requested, submit manufacturer's product certificates certifying materials comply with specified performance characteristics and criteria and physical requirements.

.4 Retain a Professional Engineer licensed to practice in the Province of Manitoba, with minimum 5 years of experience in comparable complexity and scope, to perform following services as part of work of this Section:

.1 Design of metal stud framing and connections;

.2 Review, stamp and sign fabrication and erection shop drawings and design calculations;

.3 Conduct minimum (5) on-site inspections, prepare and submit written inspection reports verifying that this part of Work is in accordance with Contract Documents and reviewed shop drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Perform in accordance with Section 01 61 00 – Common Product Requirements. Protect steel studs during transportation, site storage, and installation from corrosion and deformation.

.2 Minimize outdoor exposure in coastal areas.

.3 Storage and Handling Requirements:

.1 Store materials indoors in a clean and dry area, and in accordance with manufacturer’s recommendations.

.2 If storing outdoors is unavoidable, loosely cover members above ground with non-plastic sheets with allowances to naturally ventilate. Slope materials to drain.

.3 Carefully handle and protect galvanized materials to prevent damage to zinc coating. Isolate galvanized materials from bare steel, copper, brass, plaster, mortar, pressure preservative treated wood, and recently poured concrete.

.4 Handle and lift prefabricated panels in a way that prevents permanent distortion to any member or collateral material.

.5 Replace defective or damaged materials with new ones.

2 Products

2.1 DESIGN CRITERIA

.1 Design structural metal stud framing to withstand live, dead, wind, seismic and construction loads in accordance with the National Building Code of Canada.

.2 External Walls: Design for simultaneous exterior and interior wind pressure in accordance with NBCC2020. Interior wind pressure coefficient (Cpi) shall be -0.70 to +0.70, except that the interior wind pressure coefficient (Cpi) for the administration area shall be -0.45 to +0.30.

.3 Internal Walls: Design all interior walls for an unbalanced wind pressure of 0.75kPa, except that the unbalanced wind pressure in the administration area shall be 0.48kPa.

.4 Design systems based on Limit States Design principles using factored loads and resistances.

.5 Loads and load factors in accordance with the NBC. For wind load calculations, base the reference velocity pressure (q) on a 1 in 50 probability of being exceeded in any one year.

.6 Design in accordance with CSSBI 51 as modified by requirements of this Section including using editions of Reference Standards indicated in Part 1 of this Section.

.7 Determine resistances and resistance factors in accordance with the NBC and CSA S136.

.8 Indicate dimensions of wall stud depth on Drawings. Design wall stud steel thicknesses as required by the Design Criteria. Use greater stud depths if required by Design Criteria and as approved by the Contract Administrator.

.9 Space wall studs at a maximum of 305 mm on centre (o.c.), unless a smaller spacing distance on centre is required by the Design Criteria.

.10 Design connections to the base structures to withstand anticipated loads, including but not limited to concrete base slabs, curbs, girts, roof / floor beams, or elevated concrete slabs.

.11 Conform to the minimum design thicknesses in the following table for wall studs, unless a thicker dimension is required by the Design Criteria.

Wall Stud Depth	Minimum Base Steel Thickness Exclusive of Coating	Design Thickness Exclusive of Coating
92 mm	0.836 mm	0.879 mm
102 mm	0.836 mm	0.879 mm
152 mm	0.836 mm	0.879 mm
203 mm	1.087 mm	1.146 mm

.12 The minimum thickness for the bridging channel shall be 1.087 mm, unless a thicker bridging channel design thickness is required by the Design Criteria.

.13 The minimum thickness for clip angles shall be 1.367 mm, unless a thicker clip angle thickness is required by the Design Criteria.

.14 Maximum flexural deflections under specified wind loads shall conform to the following:

.1 Wall studs supporting with stud deflections limited to L/360.

.15 Design connections to accommodate vertical deflection movement of the building structure, frame shortening, and vertical tolerances without imposing axial loads onto the structural metal stud framing. Leave a minimum 25 gap.

.16 Limit free play in structural metal stud framing connections perpendicular to the plane of the framing to +/-0.5mm relative to the building structure.

.17 Design components and assemblies to accommodate specified erection tolerances of the building structure.

.18 Design bridging to prevent member rotation and member translation perpendicular to the minor axis. Allow for secondary stress effects due to torsion between lines of bridging. Collateral sheathing may be used to help restrain member rotation and translation perpendicular to the minor axis. Design bridging at a maximum of 1524 mm o.c. Design spacing of bridging at equal intervals over the span length of the member. Closer spacings may be required to satisfy structural requirements.

.19 Design anchorage and splice details for bridging.

.20 Design for local loading due to anchorage of cladding and interior wall mounted fixtures where indicated on Drawings.

.21 Design structural metal stud framing for a minimum superimposed vertical load of 1.5kN per square meter of wall area.

.22 Design structural stud framing for a minimum horizontal live load of 3.0kPa anywhere on the wall, applied to an 810x810 area). This load need not be combined with wind or seismic load.

.23 Design connections between wind bearing steel stud members with bolts, welding, or sheet metal screws.

.24 Design additional structural metal studs to support concentrated loads from suspended wall mounted equipment and service pipes. Design additional structural stud framing at windows, doors, louvers and other openings.

.25 Design anchor top and bottom track to the building structure at a maximum spacing of 813 mm o.c. Closer spacings may be required to satisfy structural requirements.

2.2 MATERIALS

.1 Steel: To CSA S136, fabricated from ASTM A653/A653M, Grade 230 steel.

.1 Zinc coated steel sheet: Quality to ASTM A653/A653M, with Z275 coating.

2.3 METAL FRAMING

.1 Steel studs: To CSA S136, fabricated from metallic coated steel, depth as indicated.

.1 Minimum steel thickness: Meeting Design Criteria.

.2 Steel Stud Designations: Colour code to CSSBI Technical Bulletin Vol.7, No. 2.

.3 Stud tracks: Fabricated from same material and finish as steel studs, depth to suit.

.1 Bottom track: Single piece

.2 Top track: 2-piece telescoping for internal walls where allowance for deflection of the upper structure is required.

.4 Bridging: Meeting Design Criteria

.5 Angle clips: Meeting Design Criteria

.6 Tension straps and accessories: As indicated in shop drawings

2.4 ACCESSORIES

.1 Welding Materials: To CSA W59 and certified by the Canadian Welding Bureau.

.2 Welding Electrodes: Minimum 490 MPa tensile strength series.

.3 Screws: low profile head, self-tapping sheet metal screws, minimum 0.008-mm thick zinc coating. Other coatings with equal or better protection will be considered. Cover Sheet metal screws with low profile heads with sheathing materials.

.4 Concrete Anchors: Concrete expansion anchors or other suitable drilled type fasteners, minimum 0.008-mm-thick zinc coating. Other coatings with equal or better protection will be considered.

.5 Bolts, nuts, washers: To ASTM A307 or ASTM F3125/F3125M. Hot-dipped galvanized to ASTM A123/A123M 600 g/m^2 zinc coating.

.6 Touch-up Paint: Zinc-rich, to CAN/CGSB-1.181.

.7 Powder actuated fasteners: Not permitted for fastening to concrete. Minimum 0.008-mm thick zinc coating. Other coatings with equal or better protection will be considered.

2.5 SOURCE QUALITY CONTROL

.1 When requested, submit mill reports describing material properties.

3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed are acceptable for structural metal stud framing.

.1 Inspect substrates and building structure floor flatness, and levelness. Inspect vertical structural members to ensure they are true and plumb.

.2 Proceed with installation only after unacceptable conditions are remedied.

3.2 ERECTION

.1 Erect structural metal stud framing to reviewed shop drawings and CSA S136.

.2 Perform welding in accordance with CSA W59.

.3 Erect components to requirements of reviewed shop drawings.

.4 Anchor tracks securely to structure at a maximum of 400 mm o.c., unless lesser spacing is indicated on shop drawings.

.5 Erect studs plumb, aligned, and securely attached with a minimum of 2 screws. Penetration of sheet metal screws beyond joined materials shall be not less than three exposed threads.

.6 Seat studs into bottom tracks and top tracks.

.7 Install a minimum 50-mm telescoping track at top of walls where required to accommodate vertical deflection.

.1 Nest top track into deflection channel a minimum of 30 mm and maximum of 40 mm.

.2 Do not fasten tracks together.

.3 Stagger joints of top tracks.

.8 Install studs at a maximum of 50 mm from abutting walls, openings, and each side of corners and terminations with dissimilar materials.

.9 Brace steel studs with horizontal internal bridging at a maximum 1500 mm.

.1 Fasten bridging to steel clips fastened to steel studs with screws or by welding.

.10 Frame openings in stud walls to adequately carry loads by using additional framing members and bracing as detailed on shop drawings.

.11 Cutouts: Maximum size of cutouts for services as follows:

Member Depth	Across Member Depth	Along Member Length	On Centre Spacing
92 mm	Max. 40 mm	Max. 105 mm	Min. 600 mm
102 mm	Max. 40 mm	Max. 105 mm	Min. 600 mm
152 mm	Max. 65 mm	max. 115 mm	Min. 600 mm

.1 Limit distance from centre line of last unreinforced cutout to end of member to a maximum of 300 mm.

.12 Tolerances:

.1 Plumb: Maximum 1/500th of member length

.2 Camber: Maximum 1/1000th of member length

.3 Spacing: Maximum +/-3 mm from design spacing

.4 Gap between end of stud and track web: Maximum 4 mm

3.3 SITE QUALITY CONTROL

.1 Site Tests and Inspections: Structural metal stud framing delegated design engineer responsible for shop drawings to perform the following:

.1 Periodically inspect structural metal stud framing work at Project site, including inspection of welded and screwed system connections; connections to primary building structural elements; review member sizes, locations, steel thicknesses, coating thicknesses; erection tolerances; and framing members cut or altered at the Project site.

.2 Review mill test reports.

.3 Submit report(s) and a confirmation letter signed and sealed, as described in QUALITY ASSURANCE in Part 1 of this Section.

.2 Non-Conforming Work: Replace members with localized damage.

3.4 ADJUSTING

.1 Touch-up welds with one coat of zinc-rich primer. Before applying paint, prepare surface in accordance with paint manufacturer's recommendations.

3.5 CLEANING

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning.

.3 Waste Management: Perform in accordance with Section 01 74 19 – LEED Construction Waste Management, and as follows:

.1 Protect steel waste from moisture and excessive corrosion.

.2 Separate stud framing waste from other construction waste for potential re-use in the Project or recycling.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Supply and install all miscellaneous metal work indicated on drawings and not included in the work of other Sections in addition to items listed in this Section.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless

.2 ASTM A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

.3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.4 ASTM C939, Standard Test Method for Flow of Grout for Preplaced Aggregate Concrete (Flow Cone Method)

.5 ASTM A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with improved Formability, and Ultra-High Strength

.6 ASTM C1107/C1107M, Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

.3 Canadian Standards Association (CSA):

.1 CSA G40.20-04/G40.21, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel

.2 CAN/CSA-G164-M92, Hot Dip Galvanizing or Irregularly Shaped Articles

.3 CSA-S16, Design of Steel Structures

.4 CSA-S136, North American Specification for the Design of Cold Formed Steel Structural Members

.5 CSA W47.1, Certification of Companies for Fusion Welding of Steel

.6 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum

.7 CSA W59, Welded Steel Construction (Metal Arc Welding)

.4 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating

.2 CAN/CGSB-51.32, Sheathing, Membrane, Breather Type

.3 CGSB 31-GP-105Ma, Zinc Phosphate Conversion Coatings for Paint Base

.5 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers International (NACE):

.1 SSPC-SP 1, Solvent Cleaning

.2 SSPC-SP 2, Hand Tool Cleaning

.3 SSPC-SP 3, Power Tool Cleaning

.4 SSPC-SP 6/ NACE No. 3, Commercial Blast Cleaning

1.4 QUALITY ASSURANCE

.1 All Codes and Standards referred to in this Specification shall be current editions including all latest revisions and addenda.

.2 Conform to requirements of CSA-S16, Design of Steel Structures and CAN/CSA-S136, Cold Formed Steel Structural Members.

.3 Architectural metals work shall be of the highest architectural quality, free of scratches, pitting, roughness, marring, discolouration, staining and other imperfections.

.4 Work of this Section to be executed by firm thoroughly conversant with laws, by-laws and regulations which govern, and capable of workmanship of best grade of modern shop and field practice known to recognized manufacturer's specializing in this work.

.5 Work of this Section shall be executed by workers especially trained and experienced in this type of work. Have a full time, senior, qualified representative at the site to direct the work of this Section.

.6 Where required by authorities having jurisdiction, have work of this Section designed by a professional engineer licensed to design structures and registered in the Province of the Work.

1.5 SUBMITTALS

.1 Provide submittals bearing stamp or seal and signature of the Professional Engineer responsible for the design of the work of this Section.

.2 Shop Drawings:

.1 Make thorough examination of drawings and details, determine the intent, extent, and materials, and be fully cognizant of requirements when preparing shop drawings.

.2 Submit shop drawings showing and describing in detail all work of this Section including large scale detail of members and materials, of connection and interfacing with work of other Sections, jointing details, and of anchorage devices, dimension, gauges, thicknesses, description of materials, metal finishing, as well as other pertinent data and information.

.3 Digital files of design drawings shall not be used in the preparation of shop drawings.

.3 Sustainable Design Submittals:

.1 LEED Submittals: submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Documentation identifying quantity by weight of recycled content in steel product if content is over 25% and to be claimed as such toward LEED credits.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20% of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project.

.3 Submit product data for site applied touch-up primer verifying compliance with GC-03, Green Seal Environmental Criteria for Anti-Corrosive Paints, for VOC content.

.4 Submit shop paint primer manufacturer's product data verifying compliance with MPI Green Performance Standard GPS-1, for VOC content.

1.6 STORAGE, DELIVERY, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for strategic off the ground, under cover storage locations. Do not load any area beyond the design limits.

.2 Adequately protect and crate all components against damage, dirt, disfigurement and weather during delivery and storage. Damaged materials shall not be used and shall be replaced by approved material.

.3 Cover and protect the work of other Sections in the area of work from damage. Make good all damage to the satisfaction of the Contract Administrator.

.4 Protect the installed work of this Section and on completion the work shall be examined and damage shall be remedied to the complete satisfaction of the Contract Administrator.

2 Products

2.1 MATERIALS

.1 Structural Steel Sections and Steel Plate: New stock (not weathered or rusted); to conform to CAN/CSA-G40.21, Grade 300W (44W) and Grade 350W (50W) for wide flange shapes.

.2 Hollow Structural Sections (HSS): New stock; to conform to CAN/CSA-G40.21, Grade 350W (50W), Class C, stress relieved.

.3 Sheet Steel (Structural Quality): Conforms to ASTM A1011/A1011M.

.4 Sheet Steel (Commercial Quality): Conforms to ASTM A653/A653M, stretcher levelled or temper rolled.

.5 Tube: Conforms to ASTM A53.

.6 Galvanized Sheet Steel (Commercial Quality): Galvanized coating G90 (Z275) in accordance with ASTM A653/A653M, minimized spangle, stretch levelled or temper rolled. Specially treat by phosphate conversion process conforming to CGSB 31-GP-105Ma ready to receive prime paint finish.

.7 Steel Pipe: Hot-dip galvanized, zinc coated, welded and seamless type steel pipe conforming to ASTM A53/A53M.

.8 Stainless Steel Sheet, Strip, Plate, and Flat Bars: In accordance with ASTM A666, Type 304.

.9 Non-Shrink Grout: Premixed, high strength, maximum bearing, impact resistant, non-shrink non-metallic aggregate grout having minimum 55 MPa 28 day compressive strength and conforms to ASTM C939 and ASTM C1107/C1107M, MasterFlow 816 by Master Builders Solutions, or Sika Grout 212 HP by Sika Canada Inc.

.10 Galvanizing: All uncoated steel specified to be galvanized shall be galvanized after fabrication by the hot dip process according to CAN/CSA-G164, with minimum coating of 600 g/m^2 (2 oz./sq.ft.) Galvanize after all welding is complete. Welding of galvanized material will not be permitted. Specially treat by phosphate conversion process conforming to CGSB 31-GP-105Ma ready to receive prime paint finish.

.11 Primer Paint: CISC/CPMA 2-75.

.12 Bolts, Nuts, Washers: Conforms to ASTM A325.

.13 Welding Materials: Conforms to CSA W59.

.14 Metal Filler: Polyester based type.

.15 Shop Applied Structural Steel Primer: Steel Spec Universal Primer (B50RV6227 Red), by Sherwin Williams Company of Canada Ltd., or approved equal. Apply a minimum of 2 mils dft./coat. Grey coloured primer is acceptable.

.1 Touch-up Primer (On Site): Procryl Universal Acrylic Primer by Sherwin Williams Company of Canada Ltd, or approved equal. Touch-up primer shall be no less than 3 mil dft.

.16 Zinc Rich Paint For Touch-up of Galvanized Metals: Ready mixed, zinc-rich primer conforming to CAN/CGSB-1.181, Zinc Clad No. 5 Organic Zinc Rich Primer by Sherwin Williams Company of Canada Ltd., or approved alternate.

.17 Refer to Section 09 90 00 – Painting for site finish paint requirement.

.18 Bituminous Paint: Acid and alkali resistant bituminous isolation coating.

.19 Butyl Tape: Extruded, High grade macro-polyisobutylene tape of width and shore hardness to suit conditions.

.20 Building Paper: No.15 asphalt saturated, organic felt in accordance with CSA A123.3.

2.2 FABRICATION

.1 Fit and assemble work in shop where possible. Execute work according to details and reviewed shop drawings.

.2 Take measurements at the building for work which is to fit or be connected to steel or concrete before commencing fabrication.

.3 Where shop fabrication is not possible, make trial assembly in shop.

.4 Do all welding in accordance with requirements of CSA W59, CSA W55.3 and CSA W47.1 including all supplements. Weld stainless steel electric arc process, to AWS D1.6. Grind welds smooth and flush with surface of parent metal, where exposed to view and where specifically indicated on drawings. Welds shall be continuous seam welds unless specified otherwise. Maintain sharp arises.

.5 Fit joints and intersecting members accurately in true planes, square, plumb, straight with tight joints and intersections.

.6 Provide adequate reinforcing, fastenings, anchors, accessories required for fabrication and erection of work of this Section. Such items occurring on or in an exterior wall or slab shall be hot-dip galvanized. Make thread dimensions such that nuts and bolts will fit without rethreading or chasing threads.

.7 Fabricate, drill and tap members to accommodate attachments, anchorage and work of other Sections where located and directed by them.

.8 Exposed steel surfaces shall be smooth and free from imperfections such as warping, buckling, weld marks, burrs, rust and scale.

.9 Gauges and sizes of metal shall be adequate for various conditions.

.10 Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise shown or specified. Keep exposed fastenings to an absolute minimum evenly spaced and neatly laid out. Make fastenings of permanent type unless otherwise indicated.

2.3 SHOP PAINTING AND PROTECTION

.1 As per SSPC-SP2 Hand Tool Cleaning and SSPC-SP1 Solvent Cleaning, clean welds by wire brushing and wash down with clean water, to remove the chemical residues left by the electrodes, prior to painting.

.2 Prepare steel as per SSPC-SP3 Power Tool Cleaning for interior members or SSPC-SP6 Commercial Blast Cleaning for exterior members. Remove rust, mill scale, oil, dirt, and other foreign matter before commencing shop painting.

.3 Apply shop coat of primer to all surfaces except areas requiring field welding. Apply by brush, working paint well into surfaces, interstices and cavities.

.4 Primer is to be free of runs, sags, or other collections of primer due to dipping of members into primer.

.5 Steel work shall be painted under cover, and shall remain under cover, until the paint protection is dry.

.6 Prime field welded areas after erection and touch up shop coat where damaged and barred by erection and handling.

.7 Prime steel with two full coats of paint in strict accordance with paint manufacturer's directions.

.8 Give the parts which are inaccessible after assembly two coats of primer coat paint, of different colours, when members are noted to be painted.

2.4 HOT DIP GALVANIZING

.1 Hot dip galvanize, after fabrication, steel metal fabrication items. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damaged galvanized surfaces with brush or spray-applied anti-corrosion coating containing 92-95% zinc, in accordance with manufacturer's printed directions.

.1 Members exposed to elements when in final location.

.2 Members embedded on exterior side of exterior walls.

.3 Members imbedded in concrete.

.4 Members specified in this Section or indicated on Drawings.

.2 Hot-dip galvanize members in accordance with CAN/CSA G164 and requirements of the following ASTM standards, with minimum coating weights or thicknesses as follows:

.1 Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123/A123M; average weight of zinc coating of actual surface

.1 4.8 mm (3/16”) and less member thickness: 600 g/sq.m (2 oz./sq.ft.).

.2 6 mm (1/4”) and heavier members: 640 g/sq.m (2.1 oz./sq.ft.).

.2 Iron and Steel Hardware: ASTM A153/A153M; minimum weight of zinc coating, in gram per square meter of surface, in accordance with Table 1 for the various classes of materials used in the Work.

2.5 STAINLESS STEEL FINISHES

.1 Polish Finish: Apply finish after fabrication. Remove tool and die marks and stretch lines or blend into finish. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

.1 Directional Polish: AISI No. 4 bright satin finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish, free of cross scratches. Run grain with long dimension of each piece.

3 Execution

3.1 GENERAL

.1 Verify at site that the Work to receive the work of this Section is free of irregularities detrimental to the installation and performance of the work and that it is located correctly and at proper levels before delivery and installation.

.2 Erection: To meet specified requirements of CAN/CSA-S16.

.3 Bearing Plates and Anchors: Standard.

.4 Anchors: Anchors to structural concrete shall be approved inserts set into concrete or approved self-drilling expansion insets drilled and placed afterwards.

3.2 INSTALLATION

.1 Assemble and erect work plumb, true, square, straight, level and accurate to sizes detailed, to reviewed shop drawings, free from distortion and defects detrimental to appearance and performance.

.2 Isolate contact surfaces to prevent electrolysis due to metal contact with masonry, concrete or dissimilar metal surfaces. Use bituminous paint, building paper, butyl tape or other approved means.

.3 Supply adequate instructions, templates, and if necessary, supervise installation of the fastenings or accessories requiring to be built-in by other Sections of the Work.

3.3 SCHEDULES

.1 Where items are required to be built into masonry, concrete or other work, supply such items to respective Sections with all anchors and accessories for building in.

.2 Itemized List: Supply and install metal work listed below unless specifically designated to be supplied only. Each item shall be as shown on drawings and as detailed on reviewed shop drawings.

.3 Miscellaneous Steel Framing, Channels, Angles, Plates and Brackets: As required and indicated on drawings.

.4 Loose Lintels:

.1 Provide and install loose lintels if not by structural steel.

.2 Finish: Hot-dip galvanized after fabrication.

.5 Bollards:

.1 Concrete fill steel pipe of diameters as indicated on drawings, having minimum 6 mm (1/4") wall thickness. Dome cap. Height above grade/floor shall be as indicated on drawings.

.1 In Grade Installation: Extend bollards 1500 mm (5’-0”) below grade.

.2 Co-ordinate with Section 03 30 00 – Cast-in-Place Concrete for concrete fill. Ensure that top of concrete shall be smooth and rounded.

.2 Finish:

.1 Bollard Sleeves: Extruded, high density polyethylene plastic bollard cover,

.1 Basis of Design Product: Sureguard Shields by Sureguard Security Products.

.2 Colour: Yellow.

.6 Masonry Lateral Supports:

.1 Install deflection space and lateral support for non-load-bearing masonry walls and partitions in accordance with specified requirements of CAN3-S304-M, where not provided by Section 05 12 23 – Structural Steel for Buildings.

.2 At walls with concealed tops:

.1 75 mm x 50 mm x 6 mm (3" x 2" x 1/4") angles 203 mm (8") long on both sides of walls. Anchor to structure above wall.

.3 At walls with tops exposed to view:

.1 75 mm x 50 mm x 6 mm (3" x 2" x 1/4") angles, continuous on both sides of wall. Anchor to structure above wall.

.4 Finish: Prime paint.

.7 Frames for Overhead Doors:

.1 Supply and install 6 mm (1/4") thick bent steel plate around openings at heads and jambs to suit wall thickness and return 75 mm (3") on either side of wall face. Provide extensions on interior side at head to accommodate track and operators to suit doors specified.

.2 Co-ordinate installation with other sections for anchoring. Provide proper anchors for solid installation.

.3 Finish: Hot-dip galvanized after fabrication, ready for painting by Section 09 90 00 – Painting.

.8 Overhead Doors Track Protection Guards:

.1 Provide 6 mm (1/4") thick x 1525 mm (60") high "Z" shaped bent steel plate track protection guards at overhead door tracks.

.2 Co-ordinate installation with work of other Sections. Provide proper anchors for solid installation.

.3 Hot-dip galvanized after fabrication, ready for painting by Section 09 90 00 – Painting.

.9 Entrance Vestibule Support Framing:

.1 Provide entrance vestibule support framing as required and indicated on drawings, having all welded construction. Framing shall be designed to provide a rigid trouble free support including safety factor of 3 to 1.

.2 Finish: Prime paint.

.10 Corner Guards

.1 50 mm x 50 mm x 1525 mm (2" x 2" x 60") high stainless steel corner guard, secured to metal studs framing, as indicated on the Drawings.

.11 Vertical Steel Ladders:

.1 Fabricate stringers of 13 mm x 50 mm (1/2" x 2") flat bar stock, rungs of 19 mm (3/4") steel reinforcing bars 305 mm (12") on centre, or as detailed. Shoulder weld rungs to stringers. Secure stringers 150 mm (6") free from vertical wall surface with 13 mm x 50 mm (1/2" x 2") steel brackets, located at top, bottom and intermediately at not over 1525 mm (5'-0") O.C. Height to suit site condition.

.2 Securely fasten ladders to wall, plumb, rigid and secure. Fasteners shall be not less than 9.5 mm (3/8") diameter, secured into lead expansion shields in drilled holes in wall. At roof ladders at metal siding, provide steel channel supports behind metal siding secured to steel structure for proper anchorage and support.

.3 Where required or shown on drawings, provide steel flat bar safety cages to vertical steel ladders in accordance with the Occupational Health and Safety Act, latest edition, Regulations for Industrial Establishments, latest edition, O. Regulation 851 as amended by O. Regulation 516/92 and all other authorities having jurisdiction.

.4 Finish: Prime paint interior ladders (and safety cages where required), ready for painting by Section 09 90 00 – Painting and hot-dip galvanize exterior and tower ladders after fabrication.

.5 Provide ladders for access to roofs as indicated on drawings.

.12 Under-Counter Steel Supports:

.1 Framing: Continuous channel / angle welded construction.

.2 Drill 6 mm diameter holes at each cross support for fastening of counter.

.3 Provide concealed steel section posts to support channels at front of counter, for building into wall.

.4 Provide posts with anchor plates and 9 mm diameter bolts for attachment to structure.

.5 Unless otherwise indicated, provide intermediate posts to support long counter spans.

.6 Conceal framing from view to greatest extent possible.

.7 Prime paint finish. Finish paint by Section 09 91 00.

.13 Glazed Screen Lateral Bracing:

.1 Provide and install steel channel and angle suspended support framing complete with all diagonal bracing required for lateral stability, concealed in ceiling spaces for anchorage.

.14 Exterior Vestibule Door Guard:

.1 1067 mm (3’-6”) high x 1220 mm (4’) long exterior vestibule door guard of bent aluminum flat stock 50 mm (2”) wide x 9.5 mm (3/8”) thick, clear anodized finish.

.2 Weld guard to 100 mm x 100 mm (4” x 4”) aluminum base plate, and mechanically fasten to concrete sidewalk.

.3 Weld mid-rail 406 mm (16”) from grade, as indicated on drawings.

.4 Round all corners, and grind all sharp edges.

.15 Machinery/ Traffic Guards:

.1 Weld construction, 100 mm (4”) diameter, 6 mm (0.25”) wall thickness Schedule 10 steel bent pipe, weld to 200 mm x 200 mm (8” x 8”) base plate with bolt holes for floor anchoring. Complete with midrail and powder coat finish colour yellow with black strips.

.1 Product size: 1540 mm (60-5/8”) wide x 1080 mm (42.5”) high

.2 Acceptable Product: HPRO-60-42-4 by Vestil Manufacturing Corp.

.16 Splash Plate:

.1 3 mm (1/8”) thick polished satin finish plate, minimum 600 mm (24”) high, adhere to wall around mop sink.

.17 Other Miscellaneous Metal Components:

.1 Provide steel framing and supports not specified in other Sections as needed to complete the Work.

.2 Concealed metal angles and support not included in Division 5 sections.

.3 Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

.4 Support brackets and welded plates

.5 As required and indicated on drawings.

.6 Finish:

.1 Prime paint for interior components, ready for finishing by Section 09 90 00 – Painting and hot-dip galvanized after fabrication for exterior components.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

This Section includes requirements for supply, fabrication and installation of the following:

.1 Structural Steel Stairs: Steel stair stringers will be considered as structural steel components, and shall be coordinated with Section 05 12 23 – Structural Steel for Buildings; requirements for certification and record keeping for steel stairs shall be the same as for structural steel framing, and as follows:

.2 Stairs with concrete filled treads.

.3 Industrial stairs with galvanized steel grating treads.

.2 Steel Railings, as follows:

.1 Handrails and railings attached to stairs.

.2 Handrails attached to walls adjacent to stairs.

1.3 DEFINITIONS

.1 Field Dimensions: Actual dimensions measured on site and used by fabricator to construct required assemblies.

.1 Established Dimensions: Dimensions derived from drawings or that can be reasonably determined from adjacent construction where actual dimensions required by components fabricated in this section are not available; dimensions shall have suitable tolerances so that assemblies can be adjusted on site to fit actual field dimensions.

1.4 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.2 ASTM A108, Standard Specification for Steel Bars, Carbon and Alloy, Cold-Finished

.3 ASTM A307, Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod 60,000 psi Tensile Strength

.4 ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

.5 ASTM A653/A653M, Standard Specification For Steel Sheet, Zinc Coated (Galvanized) Or Zinc Iron Alloy Coated (Galvannealed) By The Hot Dip Process.

.6 ASTM A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with improved Formability, and Ultra-High Strength

.7 ASTM 1064/1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

.3 Canadian Institute of Steel Construction (CISC):

.1 Handbook of Steel Construction, latest edition and revision.

.4 Canadian Standards Association (CSA):

.1 CAN/CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.

.2 CSA W47.1, Certification of Companies for Welding of Steel Structures

.3 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding

.4 CSA W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings

.5 CSA W59, Welded Steel Construction (Metal Arc Welding)

.5 National Association of Architectural Metal Manufacturers (NAAMM):

.1 NAAMM AMP 510-92, Metal Stair Manual

.2 NAAMM AMP 521-01, Pipe Railing Systems Manual

.3 ANSI/NAAMM MBG 531-00, Metal Bar Grating Manual, 5th Edition

.4 ANSI/NAAMM MBG 53389, Welding Specifications for Steel, Aluminum and Stainless Steel Bar Gratings, 2nd Edition.

1.5 DESIGN REQUIREMENTS

.1 Retain a Professional Engineer, registered in the province of the Work, to design details and connections of steel stairs, and ascertain that the following will comply with the requirements of the Building Code and the Contract Documents:

.1 Selection and design of connections not detailed on the Contract Documents;

.2 Fabrication of components;

.3 Erection of the work of this section.

.2 Design details and connections in accordance with requirements of CAN/CSA S16.1, and applicable codes and authorities having jurisdiction.

.3 Design gratings for 4.8 kN/m2 or a concentrated load of 4.8 kN at any point on the standard grating width.

.4 Design stair and landing sections, attachments and connections, except where members are specifically sized on the drawings, to support a minimum live load of 4.8 kN/m2 or a concentrated load of 2.0 kN at any point on indicated tread widths in accordance with Building Code.

.5 Design railing assemblies to withstand a minimum uniform load of 0.75 kN/m or a concentrated load of 1.0 kN at any point applied horizontally to top rail and a minimum of 1.5 kN/m applied vertically to top rail, with individual elements within the assembly designed for a concentrated load of 0.5 kN at any point in the element in accordance with the Building Code.

1.6 SUBMITTALS

.1 Shop Drawings: Provide shop drawings including, but not be limited to, the following:

.1 Sections and plans of stairs, railings and ladders indicating dimensions and assembly of components.

.2 Indicate fasteners, welds and connection details between stringers; treads; risers; headers; newels; platforms; struts, columns and hangers; railings; handrails; brackets; reinforcements; anchors; and welded and bolted connections.

.3 Methods and locations of all exposed fastenings.

.4 Methods and locations of specified finishes.

.5 Shop drawings requiring to be sealed by the professional engineer registered in province of work, responsible for the design.

.2 Sustainable Design Submittals:

.1 LEED Submittals: submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Documentation identifying quantity by weight of recycled content in steel product if content is over 25% and to be claimed as such toward LEED credits.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20% of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project.

.3 Submit product data for site applied touch-up primer verifying compliance with GC-03, Green Seal Environmental Criteria for Anti-Corrosive Paints, for VOC content.

.4 Submit shop paint primer manufacturer's product data verifying compliance with MPI Green Performance Standard GPS-1, for VOC content.

1.7 QUALITY ASSURANCE

.1 Detail and fabricate metal fabrications in accordance with the NAAMM AMP 510, 521, and 555; prepare fabrication and erection documents and materials lists in accordance with CSA S16.

.2 Fabricator shall have a minimum five (5) years documented experience fabricating metal stairs and railings and shall perform work of this Section to the highest standard of modern shop and field practice, by personnel experienced in architectural quality metalwork.

.3 Retain a Professional Engineer, registered in the Province of the work, to design fabrication and erection of the work of this Section in accordance with applicable Building Code and Contract Documents requirements including, but not limited to, the following:

.1 Seal and signature to shop drawings and design submittals.

.2 Field review of installed components.

1.8 SITE CONDITIONS

.1 Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings where metal fabrications are indicated to fit walls and other construction.

.2 Establish dimensions and proceed with fabricating metal fabrications where field measurements cannot be made without delaying the work; allow for trimming and fitting.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Store materials in a location and manner to avoid damage; stack materials to prevent bending or applying stress to components; keep handling of materials on-site to a minimum.

.2 Store components and materials in clean, dry location, away from uncured concrete or masonry; cover with waterproof paper, tarpaulin or polyethylene sheeting in a manner that permits air circulation inside of covering.

.3 Correct damaged material and where damage is deemed irreparable by the City, replace the affected item at no additional expense to the City.

.4 Apply protective covering to face of all exposed finished metalwork before it leaves shop, covering to remain until item installed and ready for final finishing.

.5 Fabricate large assemblies so they can be safely and easily transported and handled to their place of installation.

1.10 COORDINATION

.1 Coordinate fabrication schedule with construction progress to avoid delaying the work.

.2 Coordinate with Contractor so that field dimensions correspond to established dimensions.

.3 Coordinate shop priming and finishing requirements.

.4 Coordinate installation of anchorages for metal stairs.

.5 Supply items required to be builtin by other Sections, with instructions for installation for work not installed by this Section; install finish hardware and items supplied under other Sections required for completion of components of this Section.

.6 Coordinate nosing with specified stair finishes and set top of nosing level with top of floor finish; set materials flush with concrete surfaces where no floor finish is indicated.

2 Products

2.1 MATERIALS

.1 Use only materials that are new, free from defects that would impair the strength, durability or appearance, and of the best commercial quality for the purposes specified.

.2 Structural Steel Sections, Steel Plates and Checker Plate:

.1 New stock (not weathered or rusted); to conform to CAN/CSA-G40.21, Grade 300W (44W) and Grade 350W (50W) for wide flange shapes.

.3 Hollow Structural Sections (HSS):

.1 New stock; to conform to CAN/CSA-G40.21, Grade 350W (50W), Class C, stress relieved.

.4 Sheet Steel (Structural Quality):

.1 Conforms to ASTM A1011/A1011M

.5 Sheet Steel (Commercial Quality):

.1 Conforms to ASTM A1011/A1011M, stretcher levelled or temper rolled.

.6 Concrete Fill Stair Treads:

.1 Concrete materials and properties shall be in accordance with specified requirements in Section 03 30 00 – Cast-in-Place Concrete, and as follows:

.1 Concrete: Normal weight, ready mixed concrete conforming to CAN/CSA A3000, and having minimum 20 MPa compressive strength at 28 days.

.2 Nonslip aggregate finish: Factory packaged abrasive aggregate made from fused, aluminumoxide grit; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

.7 Steel Grating:

.1 Pressure locked type steel grating with serrated upper edges where grating is exposed to exterior conditions, thicknesses as required to support loading and conforming to Metal Bar Grating Manuals, MBG 531and MBG 532, type as approved by Contract Administrator, by Borden Metal Products (Canada) Limited, or by Dominion Bridge Company Limited, or by Robertson Building Systems, or by Armtec Inc., or by Fisher & Ludlow, Division of Harris Steel Ltd.

.2 Provide steel grating stair treads and landings with non-slip steel checker plate nosings.

.3 Provide manufacturer's standard and saddle clip type fasteners for grating.

.4 Hot-dip galvanize steel gratings and steel grating stair treads for exterior locations.

.8 Steel Pipe: Hot-dip galvanized, zinc coated, welded and seamless type steel pipe conforming to ASTM A53/A53M-12.

.9 Aluminum Materials:

.1 Aluminum Sheet and Plate: In accordance with ASTM B209-10, Type 6063T6 having clear anodized Architectural Class II Coating.

.2 Extruded Bar and Shapes: In accordance with ASTM B221-12, Type 6063T6 having clear anodized Architectural Class II Coating.

.3 Extruded Tube and Pipe: In accordance with ASTM B241/B241M-10, Type 6063T6 having clear anodized Architectural Class II Coating.

.10 Welding Materials:

.1 Conforms to CSA W59.

.11 Shop Applied Structural Steel Primer: Steel Spec Universal Primer (B50RV6227 Red), by Sherwin Williams Company of Canada Ltd., or approved equal. Apply a minimum of 2 mils dft./coat. Grey coloured primer is acceptable.

.1 Touch-up Primer (On Site): Procryl Universal Acrylic Primer by Sherwin Williams Company of Canada Ltd, or approved equal. Touch-up primer shall be no less than 3 mil dft.

.12 Zinc Rich Paint For Touch-up of Galvanized Metals: Ready mixed, zinc-rich primer conforming to CAN/CGSB-1.181, Zinc Clad No. 5 Organic Zinc Rich Primer by Sherwin Williams Company of Canada Ltd., or approved equal.

.13 Refer to Section 09 90 00 – Painting for site finish paint requirement.

.14 Non-Shrink Grout:

.1 Premixed, high strength, maximum bearing, impact resistant, non-shrink metallic aggregate grout having minimum 76 Mpa 28 day compressive strength and conforms to ASTM C939-10 and ASTM C1107/C1107M, SikaGrout 212 by Sika Canada Inc., or approved equal.

.15 Bituminous Paint: Acid and alkali resistant bituminous isolation coating.

.16 Butyl Tape: Extruded, High grade macro-polyisobutylene tape of width and shore hardness to suit conditions.

.17 Building Paper: No.15 asphalt saturated, organic felt in accordance with CSA A123.3.

.18 Galvanizing:

.1 All uncoated steel specified to be galvanized shall be galvanized after fabrication by the hot-dip process according to CAN/CSA-G164, with minimum coating of 2 oz./sq.ft. Galvanize after all welding is complete. Welding of galvanized material will not be permitted. Specially treat by phosphate conversion process conforming to CGSB 31-GP-105Ma ready to receive prime paint finish.

2.2 FABRICATION AND MANUFACTURE

.1 Design Requirements:

.1 Fabricate steel stairs to safely support live load of 100 pounds per square foot evenly distributed over treads and landings with maximum deflection of L/240. Fabricate railings to conform to the Building Code and the local authorities of jurisdiction..

.2 General:

.1 Fabricate steel stairs and railings to details indicated on Drawings and to Metal Stairs Manual, AMP 510-92.

.2 Fabricate to reviewed shop drawings and in general to details indicated on drawings and specified herein. Where possible, fit and shop assemble and deliver to site in largest practicable sections.

.3 Fabricated work shall be complete with components required for anchoring.

.4 Fit joints and intersecting members accurately with hairline joints in least conspicuous locations and manner. Make work in true plane with adequate fastenings.

.3 Welding:

.1 Except where bolted connections are indicated, make stairs of welded construction conforming to requirements of CSA W59.

.2 Grind exposed welds smooth. Machine materials and straighten in such a way that no disfigurement will show in finished work.

.4 Fastenings and Connections:

.1 Weld connections where possible. Where not possible bolt or otherwise secure in approved manner. Where approved, install exposed fastenings of same materials, colour and finish as base metal on which they occur.

.2 Countersink screws unless noted otherwise and reinforce where necessary.

.3 Use shop and field connections detailed. Where not detailed, connections shall comply with CSA S16.

2.3 COMPONENTS

.1 Steel Grating Stairs:

.1 Treads and Landings: Provide steel grating landings and stair treads where indicated on drawings, reinforced as required. Form open riser grating stair treads and landings from steel grating with checker plate nosings. Fasten open riser stair treads to stringers with concealed brackets.

.2 Stringers: Steel stringer channel unless otherwise noted, with 14 gauge formed fascia where indicated.

.3 Balusters and Handrails: Provide balustrades, railings and handrails as indicated on drawings, complete with brackets and anchoring devices.

.4 Framing: Structural steel framing, angles, channels, trimmers, posts and columns, channel bearings, support angles and clip angle connections to floor slabs and walls.

.5 Finish: Hot-dip galvanize after fabrication.

.2 Floor Plate: Hot dip galvanized steel plates, diamond shaped raised pattern, minimum 6 mm (1/4") thick exclusive of raised pattern, angle stiffener reinforced as required, cast-in angle supports and frames.

.3 Railings and Handrails:

.1 Provide floor and wall mounted railings and handrails as indicated on drawings, complete with brackets, posts, guards, anchoring devices and removable sections.

.2 Finishing:

.1 Steel: After shop fabrication, thoroughly de-scale steelwork, remove roughness and irregularities by grinding, clean with wire brush, remove oil and grease from surface of steel and give one coat of primer. Give steelwork one coat of primer in shop working well into crevices and interstices. Leave ready for finish painting by Section 09 90 00 – Painting. Hot-dip galvanized exterior steel railings and handrails.

.2 Aluminum: Satin finish.

.4 Stair Nosing Tactile Warning Devices:

.1 For grating treads:

.1 Heavy duty, slip resistance surface fiberglass reinforced plastic nosing, colour yellow. Overall depth 75 mm (3"). Sure-Foot Stair Nosing by Grainger Canada.

.2 For steel pan concrete filled treads:

.1 Extruded aluminum, 75 mm (3") deep nosing with slip resistant inserts consisting of aluminum oxide and silicon carbide granules in an epoxy matrix locked into the extruded channels of the base, projecting minimum of 1/16" above extruded channels, colour safety yellow.

3 Execution

3.1 EXAMINATION

.1 Examine the work of other Sections upon which the work of this Section depends and report any defects to the Contract Administrator. Do not commence installation until such time as all wet trades have been completed. Commencement of work implies acceptance of surface and conditions.

3.2 PREPARATION

.1 Provide anchorage devices and fasteners to other Sections where necessary for securing metal stairs to in place construction; include threaded fasteners for concrete and masonry inserts, throughbolts, lag bolts, and other connectors.

.2 Perform cutting, drilling, and fitting required for installing metal stairs.

.3 Field check and verify that structural framing, enclosures, weld plates, blocking, and that size and location of pockets are placed in accordance with reviewed shop drawings.

.4 Report discrepancies to Contractor and Contract Administrator, and recommend corrective action by responsible parties.

.5 Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

.6 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates and instructions for installation.

3.3 INSTALLATION

.1 Furnish, set and secure framing brackets, hangers, anchors, inserts or similar supports for proper erection of stairs before masonry and concrete is placed. Provide temporary supports and bracing required to position stairs and railings.

.2 Do all coring, drilling and fitting necessary to attach work of this Section to adjoining work.

.3 Continuous weld connections between handrails and balusters and in lengths of handrails.

.4 Secure wall brackets to wall at 1220 (4') O.C. maximum with through-bolts and plate where these can be concealed, otherwise use bolts and expansion shields to achieve maximum rigidity of rail. Wood plugs for fixing to walls will not be permitted. Use metal anchoring devices.

.5 Grout bases of posts, balusters or newels occurring in concrete using non-shrink grout in accordance with manufacturer's instructions. Finish smooth, level and flush with surrounding finished surface.

.6 Isolate contact surfaces to prevent electrolysis due to metal contact with masonry, concrete or dissimilar metal surfaces. Use bituminous paint, building paper, butyl tape or other approved means.

.7 Grind off surplus welding materials and provide sharp profiles and arrises.

.8 Build and erect work plumb, true, square, straight, level and accurate, to sizes detailed, to reviewed shop drawings, free from distortion or defects detrimental to appearance and performance.

.9 Touch up with matching primer, or zinc rich paint for galvanized components, field welds, damaged and abraded surfaces, and surfaces not previously primed. Leave ready for finish painting by Section 09 90 00 – Painting.

.10 Stair Nosing:

.1 Install nosings grating treads before concrete has set. Hand trowel treads to a swirl, non-slip surface.

.2 Install nosings for steel pan concrete filled treads:

.1 Clean, dry and prepare surface to product supplier’s recommendation.

.2 Cut nosing with abrasive disc, jigsaw or hacksaw to stair width.

.3 Use fastener attached nosing to grating surface, apply fastener at 600 mm (2’) apart.

3.4 PROTECTION

.1 Protect completed work from damage during and after installation.

.2 Field repair or refinishing of damaged, marred or discoloured finishes will not be accepted.

3.5 CLEANING

.1 Clean installations and assemblies progressively as work proceeds, and at completion of work.

Remove protective coverings and clean metal work using cleaning solutions and methods to suit the metal and its finish at completion of work.

Protect adjacent materials and finishes from damage or discolouring during cleaning.

At completion, remove all equipment, tools, surplus materials and debris from job site.

3.6 STAIR AND RAILING SCHEDULE

.1 Stair Type STR-1:

.1 Stringers: Structural Steel Channel, Open Face, size in accordance with delegated design requirements; having a minimum 25mm (1") clear between tip of nosing and back of tread to face of channel; close ends of stringers where exposed.

.2 Treads and Risers:

.1 Construction: Concrete filled pan, closed riser.

.2 Deflection: L/360

.3 Nosing: Extruded aluminum with abrasive ribs embed to edge of concrete treads.

.4 Landings and Platforms: Concrete filled steel pan reinforced with channels, to provide smooth soffit surface.

.5 Railings: Pipe as detailed on Drawing, return ends to wall.

.6 Handrails: Pipe Rail

.2 Stair Type STR-2:

.1 Stringers: Structural Steel Channel, Open Face, size in accordance with delegated design requirements; having a minimum 25mm (1") clear between tip of nosing and back of tread to face of channel; close ends of stringers where exposed.

.2 Treads and Risers:

.1 Construction: Steel grating welded to stringer, open riser.

.2 Deflection: L/360

.3 Nosing: FRP surface mounted to grating treads edges.

.4 Landings and Platforms: Steel grating.

.5 Railings: Pipe as detailed on Drawing, return ends to wall.

.6 Handrails: Pipe Rail

.3 Stair Type STR-3:

.1 Stringers: Structural Steel Channel, Open Face, size in accordance with delegated design requirements; having a minimum 25mm (1") clear between tip of nosing and back of tread to face of channel; close ends of stringers where exposed.

.2 Treads and Risers:

.1 Construction: Checkered profile safety plate, open riser.

.2 Deflection: L/360

.3 Nosing: FRP surface mounted to steel treads edges.

.4 Landings and Platforms: Steel grating.

.5 Railings: Pipe as detailed on Drawing, return ends to wall.

.6 Handrails: Pipe Rail

3.7 PIPE HANDRAIL AND GUARDRAILING SCHEDULE

.1 Provide handrails and guardrails of the minimum diameter, standard weight pipe required to resist design loads, and as follows:

.1 Return ends of metal handrails toward guardrail after 305mm (12") of straight run, with radius corners, leaving 200mm (8") space between returned end and handrail.

.2 Space guardrail pickets a maximum of 100mm (4”) o.c.

.3 Design railings, and supports, in accordance with loads specified in the Building Code.

.4 Extend handrail horizontally not less than 300 mm (12”) beyond the top riser, and continue to slope for a depth of one tread beyond the bottom riser followed by a 300 mm horizontal extension. At ramps, extend handrail horizontally at the required height, not less than 300 mm (12”) beyond the top and bottom edges of the incline of ramp or stairway in accordance with Building Code.

.5 Weld handrail and guardrail to stringer as indicated on Drawings.

.6 Cap the ends of tube rails with 3mm (1/8”) steel plate. Weld all around.

3.8 PIPE HANDRAIL AND WALL BRACKETS SCHEDULE

.1 Provide handrails and brackets of the minimum diameter, standard weight pipe required to resist design loads, outer diameter 40mm (1.6”) unless otherwise indicated on the drawings, and as follows:

.1 Return ends of metal wall handrails toward wall with radius corner and stop handrail 13mm (1/2") from wall with flat end.

.2 Space brackets at a maximum of 1220mm (4’) and not more than 305mm (12”) from the ends.

.3 Design railings, and supports, in accordance with loads specified in the Building Code.

.4 Extend at least one handrail horizontally not less than 300 mm (12”) beyond the top riser, and continue to slope for a depth of one tread beyond the bottom riser followed by a 300 mm horizontal extension. At ramps, extend at least one handrail horizontally at the required height, not less than 300 mm (12”) beyond the top and bottom edges of the incline of ramp or stairway in accordance with Building Code.

.5 Weld posts to castin designed to resist post loads in accordance with the Building Code.

.6 Cap the ends of tube rails with 3mm (1/8”) steel plate. Weld all around.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 DEFINITIONS

.1 Handrails: Synonymous with guard rail system, railing system, ramp-rail system, and stair-rail system; comprising of a combination of vertical, horizontal, or inclined members, panels, and accessories.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 DESIGN REQUIREMENTS

.1 Design details and connections, where not shown on Drawings, in accordance with CAN/CSA S16, CSA S136, and CSA S136.1.

.2 Comply with CSA S157/A157.1 for strength design in aluminum work.

.3 Platform: Unless otherwise indicated, minimum uniform loading of 9.8 kPa (200 psf) at maximum deflection of L/360 of clear span.

1.5 QUALITY ASSURANCE

.1 Retain a Professional Engineer, licensed in the Province of the Work, with experience in Work of comparable complexity and scope, to perform the following services as part of the Work of this Section:

.1 Design work as required to resist live, dead, lateral, wind, and seismic loads.

.2 Structural design.

.3 Review, stamp, and sign shop drawings.

.4 Conduct shop and on-site inspections.

.5 Prepare and submit inspection reports.

.2 Do steel welding to CSA W59 by fabricators certified by the Canadian Welding Bureau to CSA W47.1.

1.6 SUBMITTALS

.1 Shop Drawings: Bearing professional seal and signature of the professional engineer responsible for the engineering design. Show work of this Section including large scale detail of members and materials, of connection and jointing details, and of anchorage devices, dimensions, thicknesses, description of materials, metal finishing, as well as other pertinent data and information.

.2 Sustainable Design Submittals:

.1 LEED Submittals: submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Documentation identifying quantity by weight of recycled content in steel product if content is over 25% and to be claimed as such toward LEED credits.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20% of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project.

.3 Submit product data for site applied touch-up primer verifying compliance with GC-03, Green Seal Environmental Criteria for Anti-Corrosive Paints, for VOC content.

.4 Submit shop paint primer manufacturer's product data verifying compliance with MPI Green Performance Standard GPS-1, for VOC content.

2 Products

2.1 MATERIALS

.1 Steel Shapes, Plates: CAN/CSA-G40.20-G40.21-M, Grade 350W.

.2 Hollow Steel Sections: CAN/CSA-G40.20/G40.21-M, Grade 350W, Class H.

.3 Steel Handrails and Posts: ASTM A53, Type S, Schedule 40, Grade A, steel pipe of sizes shown.

.4 Galvanized Sheet Steel: ASTM A653/A653M Grade A, Z275 Commercial Quality zinc coating, size and shape as shown.

.5 Grating: Rectangular grate opening, serrated top edge, 30 mm centre rectangular bearing bars, 100 mm centre rectangular cross bars, welded construction, corners and junctions ground smooth. Weld perimeter banding bars, same size as bearing bars, at grating edges and openings. Attach welded anchors at 600 mm centres.

.6 Fasteners: Bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws and machine bolts hot dipped galvanized to CSA G164. For joining stainless steel components use stainless steel fasteners.

.7 Primer Paint: CISC/CPMA 2-75.

.8 Galvanizing Touch Up Paint: High zinc dust content, Zinc Clad 5 by Sherwin Williams.

.9 Grout: Non-shrink, non-metallic, flowable, 24h, 15 MPa (2100 psi), pull-out strength 7.9 MPa (1150 psi).

.10 Drilled Anchors: Mega by ITW Construction Products or HSL by Hilti Inc. heavy-duty anchors, sizes to suit.

.11 Bituminous Paint: Acid and alkali resistant bituminous isolation coating.

.12 Butyl Tape: Extruded, High grade macro-polyisobutylene tape of width and shore hardness to suit conditions.

.13 Building Paper: No.15 asphalt saturated, organic felt in accordance with CSA A123.3.

2.2 FABRICATION

.1 Verify dimensions of existing work before commencing fabrications and report any discrepancies to Contract Administrator.

.2 Fit and assemble work in shop where possible. Execute work in accordance with details and reviewed shop drawings. Where shop fabrication is not possible, make trial assembly in shop.

.3 Unless indicated otherwise, provide welded connection for work of this Section.

.4 Screw Assembly: Use self-tapping shake-proof screws on items requiring assembly by screws.

.5 Seal exterior steel fabrications against corrosion in accordance with CAN/CSA S16.

.6 Carefully make and fit details. Take special care with exposed finished Work to produce a neat and correct appearance to Contract Administrator's acceptance.

.7 Assemble members without twists or open joints.

.8 Correctly size holes for connecting work of other Sections where such can be determined prior to fabrication. Where possible, show holes on shop drawings. Place holes not to cause appreciable reduction in strength of member.

2.3 WELDING

.1 Perform welding by electric arc process.

.2 Execute welding to avoid damage or distortion to work. Execute welding in accordance with following standards:

.1 CSA W48: For welding materials. If rods are used, only coated rods are allowed.

.2 CSA W59 Series: For design of connections and workmanship.

.3 CAN/CSA W117.2: For safety.

.3 Thoroughly clean welded joints and expose metals for a sufficient distance to perform welding operations.

.4 Test welds for conformance and remove work not meeting specified standards and replace to Contract Administrator's acceptance.

.5 Continuous weld all joints for the full length of each joint. Finish exposed welds smooth and flush, file or grind as required.

2.4 ANCHORS AND FASTENING

.1 Use weld studs of size not larger than 10 mm for attaching miscellaneous materials and equipment to building steel structure. If weight of item requires larger fasteners use clips or brackets and secure by welding or through bolting.

.2 Use self-drilling expansion type concrete anchors for attaching to masonry and concrete.

.3 Do not secure items to steel deck.

.4 Use steel beam clamps of two bolt design to transmit load to beam web. Do not use C and I clamps.

.5 Before openings are cut through structure, obtain Contract Administrator's written acceptance for procedures, locations and reinforcements required.

.6 Do not weld hangers to structural steel members or burn holes in structural steel.

2.5 SHOP PRIMING

.1 Clean steel to SSPC SP6 and remove loose mill scale, weld flux and splatter.

.2 Shop prime steel with one coat of primer paint to dry film thickness of 0.07 mm. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 deg C. Paint items under cover and leave under cover until primer is dry. Follow paint manufacturer's recommendations regarding application methods, equipment, temperature, and humidity conditions.

.3 Clean but do not prime surfaces to be field welded.

.4 Do not prime surfaces embedded in concrete, clean as if they were to be primed.

.5 Do not prime machine finished surfaces, but apply an effective anti-rust compound.

.6 Take precautions to avoid damage to adjacent surfaces.

2.6 HOT DIP GALVANIZING

.1 Hot dip galvanize, after fabrication, steel metal fabrication items. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damaged galvanized surfaces with brush or spray-applied anti-corrosion coating containing 92-95% zinc, in accordance with manufacturer's printed directions.

.1 Members exposed to elements when in final location.

.2 Members embedded on exterior side of exterior walls.

.3 Members imbedded in concrete.

.4 Members specified in this Section or indicated on Drawings.

.2 Hot-dip galvanize members in accordance with CAN/CSA G164 and requirements of the following ASTM standards, with minimum coating weights or thicknesses as follows:

.1 Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123/A123M; average weight of zinc coating of actual surface

.1 4.8 mm (3/16”) and less member thickness: 600 g/sq.m.

.2 6 mm (1/4”) and heavier members: 640 g/sq.m.

.2 Iron and Steel Hardware: ASTM A153/A153M; minimum weight of zinc coating, in gram per square meter of surface, in accordance with Table 1 for the various classes of materials used in the Work.

3 Execution

3.1 EXAMINATION

.1 Verify dimensions and conditions of previously installed work, upon which this Section depends, and coordinate repairs, alterations, and rectification if necessary.

.2 Obtain Contract Administrator’s written approval prior to field cutting or altering of structural members.

3.2 ERECTION

.1 Fit joints and intersecting members accurately. Make work in true planes with adequate fastenings. Build and erect Work plumb, true, square, straight, level and accurate to sizes detailed, free from distortion or defects detrimental to appearance or performance.

.2 Perform drilling of concrete and steel as required to fasten Work of this Section.

.3 Continuously weld connections for railings, and anchor directly to steel stringers. Where rails return to wall have end returns and wall brackets.

.4 Unless otherwise indicated, grout set work in concrete with non-shrink grout. Trowel surface smooth and flush with adjacent surfaces.

.5 Isolate contact surfaces to prevent electrolysis due to metal contact with masonry, concrete or dissimilar metal surfaces. Use bituminous paint, building paper, butyl tape or other approved means.

.6 Grating: Fabricate removable and fixed gratings in sections weighing maximum 75 kg (165 lbs) each. Secure removable grating in place with minimum of 4 clips per panel. Weld fixed gratings at approximately 400 mm (16") oc with 25 mm (1") fillets.

3.3 FIELD PAINTING

.1 Paint bolt heads, washers, nuts, field welds and previously unpainted items. Touch up shop primer damaged during transit and installation, with primer to match shop primer.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Supply all labour, materials, equipment, services and perform all operations required to complete all rough carpentry work to the full intent of the drawings and as herein specified.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 SUBMITTALS

.1 Sustainable Design Submittals:

.1 LEED Submittals: Co-ordinate submittals requirements.

.2 LEED Submittals: Submit LEED submittal forms for Credit EQ 4.4 in accordance with the following:

.1 Composite Wood products including core materials, must contain no added urea-formaldehyde resins.

.2 Adhesives used to fabricate laminated assemblies must contain no urea-formaldehyde.

.3 Provide certificates by Forestry Stewardship Council Chain of Custody for wood materials in compliance with LEED Credit MR 7.

.1 Provide proof of FSC Certified Millwork shop.

1.5 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off-the-ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Do not store seasoned materials under conditions that will cause their moisture content to increase.

.4 Protect edges and corners of sheet materials from damage during handling and storage.

.5 Store preservativetreated materials under cover, off the ground and protected from moisture.

2 Products

2.1 MATERIALS

.1 Framing Lumber:

.1 Lumber for structural components shall be of species and grade specified, well seasoned, processed and stamped at same mill with appropriate grade markings. Conform to requirements of Standard Grading Rules for Canadian Lumber of National Lumber Grades Authority the (NLGA) with latest supplements, approved by the Canadian Lumber Standards Administrative Board.

.2 Framing, Furring, Strapping, Blocking:

.1 Spruce, 122c, "Standard" light framing, except as otherwise specified.

.3 Rough Hardware:

.1 Provide rough hardware such as nails, spikes, staples, H-clips, bolts, nuts, washers, screws, clips, strap iron and including hardware for temporary enclosures. Nails for plywood shall be annular or spiral type, all other nails shall be spiral type. All nails, spikes and staples shall conform to CSA B111. All rough hardware shall be galvanized unless otherwise noted. Galvanizing shall conform to CAN/CSA-G164.

.4 All Other Materials and Hardware:

.1 Shall be as noted on drawings.

2.2 PRESSURE PRESERVATIVE TREATED MATERIALS

.1 Pressure Preservative Treated Lumber: Lumber graded and stamped in accordance with applicable grading rules and standards of associations or agencies approved to grade lumber by Canadian Lumber Standards Accreditation Board in accordance with CAN/CSA O80.

.1 Species: Pine or SprucePine

.2 Grade: No.2 or better structural posts and lumber, pieces may be grade stamped or shipment certified by letter of compliance.

.3 Grading authority: NLGA, paragraph 131CC

.4 Material having twisted grain or structural defects affecting integrity of lumber will not be acceptable for this project.

.5 Use only material with radius edges, minimum 6 mm.

.6 Kiln dry lumber materials to 8% moisture content or less.

.2 Pressure Preservative Treated Plywood: Treated in accordance with CAN/CSA O80 using water-borne preservative to obtain minimum net retention of 4 kg/m^3 (0.25 lb/ft^3) of wood. Plywood or laminated materials shall be manufactured with exterior grade adhesives. After treatment, plywood shall be kiln dried to moisture content of 8% or less.

2.3 PRESSURE FIRE RETARDANT TREATED MATERIALS

.1 Treat by pressure impregnation with fire-retardant chemicals in accordance with CAN/CSA O80 to provide classification for flame spread of not more than 25, smoke developed of not more than 75 in accordance with CAN4 S102.

.2 All fire retardant wood must comply with the requirements in AWPA Standard C20 for lumber and C27 for plywood.

.1 AWPA C20: Structural Lumber, Fire-Retardant Pressure Treatment, lumber materials shall only be of species listed. After treatment, lumber 50 mm (2”) or less in thickness shall be kiln dried to moisture content of 8% or less.

.2 AWPA C27: Plywood, Fire-Retardant Pressure Treatment, plywood or laminated materials shall be manufactured with exterior grade adhesives. After treatment, plywood shall be kiln dried to moisture content of 8% or less.

.3 All species to comply with CAN4 S102 for surface-burning characteristics and shall bear identification showing classification and type of fire retardant.

.3 Each piece or bundle of fire-retardant treated material or panel to bear ULC inspection label or stamp attesting to FRS rating indicating flame spread, smoke developed, and fuel contributed classification meeting AWPA standard C20 and C27 for Type A Use.

.4 Fire retardant chemicals used to treat lumber must comply with FR-1 of AWPA Standard P17 and shall be free of halogens, sulphates and ammonium phosphate.

.5 Acceptable materials: Plywood and lumber materials treated by licensed applicators with fire retardant materials from the following:

.1 Dricon FRTW by Hickson Corporation.

.2 Pyro-Guard by Hoover Treated Wood Products Inc.

.3 D-Blaze by Chemical Specialties Inc.

3 Execution

3.1 INSTALLATION-GENERAL

.1 Consult with and co-operate with other Sections in advance and build-in or make provisions for installation of other work.

.2 Provide and fit in place all furring, strapping, battens, nailers, sleepers, grounds and blocking required to provide adequate properly placed fixing for all wood finishes, fitments and as required for the work of others trades.

.3 Blocking, strapping and other rough carpentry indicated shall not be regarded as complete or exact. Provide all rough carpentry work required, whether specifically shown or not. Grounds shall be of a thickness to provide for application of finishes. Room side surfaces of grounds shall be plumb and in true plane throughout.

.4 All nails shall be long enough so that at least half their length penetrate in to the second member. Splitting of wood members shall be minimized by staggering the nails in the direction of the grain and by keeping nails well in from edges.

.5 Blocking shall be through-bolted to structure.

.6 Anchor rough bucks to concrete or masonry with 9.5 mm (3/8") diameter expansion bolts and shields or Drummond and Reeves security buck anchors, minimum three per jamb.

3.2 WOOD BLOCKING, CANTS AND NAILERS

.1 Provide wood blocking, cants and nailers, where shown to be required as detailed. Bolt securely in place. Block under cants same thickness as installed roof insulation.

.2 Check mechanical, electrical, architectural drawings and provide all blocking, cants, nailers etc. required. Leave work ready for built-up bituminous roofing and prefinished sheet metal flashings.

3.3 PLYWOOD EQUIPMENT PANELS

.1 Provide plywood panels required for electrical/telephone mounting of equipment and in other locations as indicated on drawings.

3.4 PRESSURE PRESERVATIVE TREADED WOOD INSTALLATION

.1 Comply with AWPA M4.

.2 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation. Allow first coating to fully soak into grain before applying second coating in accordance with manufacturer’s instructions.

.3 Remove with fine sandpaper, chemical deposits on treated wood to receive applied finish.

.4 Use only hot-dipped galvanized, corrosion resistant nail or screw fasteners. Staples are not acceptable for installation of preservative treated materials.

.5 Use water-borne preservative treated wood for:

.1 Wood in contact with masonry or concrete,

.2 Wood within 450 mm (18”) of grade,

.3 Wood in contact with flashings,

.4 Wood in contact with waterproofing membranes, confirm compatibility with membrane manufacturer prior to application.

3.5 PRESSURE FIRE RETARDANT TREATED WOOD INSTALLATION

.1 Field Cuts:

.1 Do not rip, mill or conduct extensive surfacing of fire retardant treated lumber, label will be voided.

.2 Only end cuts, drilling holes and joining cuts are permitted.

.3 All cuts on plywood will be considered end cuts.

.4 Fire-retardant lumber and plywood can be given a light sanding for cosmetic cleaning after treatment.

.5 Pre-cut to the greatest extent possible before treating.

.2 Fire retardant treated plywood used in structural applications shall be graded or span-rated material.

.3 Use only hot-dipped galvanized, corrosion resistant nail or screw fasteners. Staples are not acceptable for installation of fire resistant treated materials.

.4 Where humidity conditions are such that moisture may condense between hardware and treated wood, hardware shall be backprimed with a corrosiveinhibitive paint.

.5 Backprime at contact points and fasteners to prevent electrolysis when fire retardant framing members are used in metal buildings.

END OF SECTION

1 General

1.1 SUMMARY

.1 Supply all labour, materials, equipment, services and perform all operations required to complete all finish carpentry installation including but not limited to the following:

.1 Custom casework with plastic laminated finish.

.2 Countertops.

.3 Cabinet hardware.

.4 Hardwood Trim and accessories

1.2 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.3 PERFORMANCE REQUIREMENTS

.1 Design cabinets capable of withstanding the effects of earthquake motions determined according to applicable code. Provide anchorage on cabinets exceeding 1200 mm in height or, where they are likely to be hazard from overturning.

1.4 QUALITY ASSURANCE

.1 Contractor executing work of this section shall have a minimum of five (5) years continuous Canadian experience in successful manufacture/fabrication and installation of work of type and quality shown and specified. Submit proof of experience upon Contract Administrator's request.

.2 Follow applicable requirements of The Architectural Woodwork Manufacturer's Association of Canada (AWMAC) Standard for Millwork latest edition, including supplements and modifications.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

.1 Coordinate with other work having a direct bearing on work of this Section.

.2 Coordinate the work with mechanical, electrical and electrical rough-in, installation of associated and adjacent components.

.3 Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other sections to ensure that cabinets can be supported and installed as indicated.

.1 Coordinate metal reinforcement by Section 09 21 00 – Gypsum and Cement Board Assemblies with mounting requirements and wall cleats for wood paneling, base and upper cabinets and accessories.

.2 Pre-installation Meeting:

.1 Convene one (1) week before starting work of this Section; conduct meeting at Project site.

.2 Require attendance of the Contract Administrator, Installer, Manufacturer and other parties directly affected by the work of this Section.

.3 Review preparation and installation procedures, coordination and scheduling required with related work, referenced installation standards, manufacturer's installation instructions and warranty requirements.

.4 Prepare and distribute minutes of meeting to the City and participating parties.

1.6 SUBMITTALS

.1 Product Data:

.1 Provide data for panel products, cabinet hardware and accessories, and finishing materials and processes.

.2 Shop Drawings: Submit detailed shop drawings of all shop fabricated finish carpentry components.

.1 Indicate materials, component profiles, plans, sections and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.

.2 Show locations and sizes of cutouts and holes for plumbing items, electrical wiring, switches, and outlets, and other items installed in cabinets.

.3 Samples: Submit two (2) samples prior to fabrication works for each color and types as specified to the following:

.1 300 x 300 mm size of high pressure decorative laminate

.2 300 x 300 mm size of wood veneer finishes

.3 300 x 300 mm size of solid surfacing material

.4 Exposed Fasteners, Hardware and Accessories: One unit for each type and finish.

.4 Sustainable Design Submittals:

.1 LEED Submittals: Co-ordinate submittals requirements.

.2 LEED Submittals: Submit LEED submittal forms for Credit EQ 4.4 in accordance with the following:

.1 Composite Wood products including core materials, must contain no added urea-formaldehyde resins.

.2 Adhesives used to fabricate laminated assemblies must contain no urea-formaldehyde.

.3 Provide certificates by Forestry Stewardship Council Chain of Custody for wood materials in compliance with LEED Credit MR 7.

.1 Provide proof of FSC Certified Millwork shop.

1.7 DELIVERY, STORAGE, HANDLING & PROTECTION

.1 Do not permit delivery of work of this section to site until area is sufficiently dry so that woodwork will not be damage by excessive changes in moisture content.

.2 Coordinate deliveries to comply with construction schedules and arrange ahead for under cover storage location.

.3 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect material with suitable non-staining waterproof coverings.

.4 Store material in original, undamaged containers or wrappings.

.5 Unsatisfactory materials shall be promptly removed from the site.

.6 Adequately protect the structure and work of other sections during delivery, storage, handling and execution of the work of this section.

.7 Provide tools, plant and other equipment required for the proper execution of the work of this section.

1.8 SITE CONDITIONS

.1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on Shop Drawings where casework is indicated to fit walls and other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work; locate concealed framing, blocking, and reinforcements that support woodwork by site measurements before being enclosed and indicate measurements on Shop Drawings.

.2 Established Dimensions: Establish dimensions and proceed with fabricating casework without confirmed site measurements where site measurements cannot be made without delaying the Work; coordinate with the construction to ensure that actual dimensions correspond to established dimensions; allow for trimming and fitting.

.3 Ambient Conditions: Maintain area or room in which casework is being installed at a uniform temperature and humidity for 24 hours prior to, during and after installation in accordance with AWS for relative humidity and moisture content; provide additional lighting to maintain a minimum of 430 lx on surfaces and areas where casework is being installed.

1.9 WARRANTY

.1 Warrant plastic laminate work of this Section against defects in materials and workmanship in accordance with General Conditions but for an extended period of two (2) years and agree to repair or replace faulty materials or work which appears during warranty period, without cost to the City. Defects shall include but not be limited to, opening of joints, cracking, shrinkage, warpage, delamination of plastic laminate.

2 Products

2.1 LUMBER AND PANEL MATERIALS

.1 Framing Lumber:

.1 Lumber for structural components shall be of species and grade specified, well seasoned, and processed and stamped at same mill with appropriate grade markings. Conform to requirements of standard grading rule for Canadian lumber of Nation Lumber Grades Authority (NLGA) latest issue, approved by Canadian Lumber Standards Administrative Board, as follows:

.1 Rough Carpentry for built-in work: No. 2 select grade Ontario white pine.

.2 Blocking, Ground, Furring and Strapping, Bucks and Nailing Strips: C.L.A. No. 1 grade pine, kiln dried stock.

.3 Non-Exposed Softwood: Fabricator's option, meeting requirements of CAN/CSA O141-05(R2009), kiln dried for interior use to a moisture content of 4% to 8%, and 7% to 10% for exterior use; Surface 4 sides (S4S).

.2 Hardwood: Oak, Birch, Ash, Maple or other species, as indicated on drawings and conforms to requirements of AWMAC Custom Grade and NHLA Select Grade.

.3 Panel Materials:

.1 Plywood: Douglas Fir veneer core plywood, 19mm (3/4") thick or thickness as indicated on drawings, Select Sheathing-Tight Face, good two sides, sanded "B" faces and conforms to CSA O121.

.2 Particleboard: ANSI A208.1, 700 kg/m^3 density.

.3 Medium density fibreboard (MDF): ANSI A208.2, density minimum 750 kg/m^3, moisture resistant; standard of acceptance: Premier Plus MR MDF by Flakeboard.

.4 Solid Surface Panel: 6mm (1/4") thick homogeneous composite of natural minerals and prime acrylic polymer. Colour: As selected by the Contract Administrator from the manufacturer's standard product line.

2.2 LAMINATE MATERIALS

.1 Plastic Laminate: NEMA LD3, continuous (through) colour high pressure decorative laminate (HPDL), Grade VGS; selected from manufacturer's full colour range, with matte and high gloss finishes.

.1 Refer to Schedule of Finishes for type, product and colour.

.2 Cabinet Liner: NEMA LD3, Grade CLS, not less than 0.5 mm thick.

.1 Colour: White.

2.3 CASEWORK

.1 Plastic Laminate Casework:

.1 Grade: NAAWS Premium Grade.

.2 Sheet Core: Minimum 19 mm thick Veneer core plywood to meet NAAWS grade specified.

.3 Construction Type: NAAWS construction type to be Frameless.

.4 Cabinet and door interface: flush overlay.

.5 Exposed Surfaces: HPDL, colour, finish and pattern direction, meeting requirements of NAAWS for Grade specified.

.6 Exposed interior surfaces: HPDL matching exposed surfaces.

.7 Semi-exposed surfaces: Cabinet liner matching exposed surfaces.

.8 Edgeband: HPDL

.1 Edgeband at doors, drawer fronts, and false fronts: 3 mm thick. Colour and texture to match casework face.

.2 Drawers: NAAWS Premium Grade:

.1 Side Construction: Baltic Birch Veneer core plywood core, 12 mm thick core, dovetailed or lock-shoulder jointed into 15 mm body and back.

.2 Bottom Construction: Baltic Birch Veneer core plywood, 6 mm material, dadoed into body (subfront and back) and sides.

.3 Drawer Face: Matching cabinet exposed surface finish and core material.

.4 Finish:

.1 Side back and sub-face: to match casework semi-exposed finish.

.2 Drawer face: to match casework exposed surface finish.

.3 Wall Cabinets: NAAWS Premium Grade, with finish to match base cabinets.

.1 Provide top and bottom Fillers and Corner Panels.

.2 Provide scribes and fillers with a max. 25 mm exposed dim.

.3 Underside of Cabinets: Type 'B' flush (one tight joint line visible)

.4 Provide custom valances at underside of cabinets as shown.

.5 Wall Cabinet Bulkheads: Provide custom wood paneling as shown.

.6 Cabinet Backs (Wall Hung Cabinets): Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members.

.4 Shelving: NAAWS Premium Grade.

.1 Construction: To match Exposed panel products.

.2 Core: to meet NAAWS grade and loading requirements.

.3 Panel Edge Band: To match exposed panel product finishes.

.4 Provide adjustable shelves in all cabinets, set shelf standards flush with surface of gables unless shown or called for otherwise. Set shelf brackets within cabinets flush with underside of shelf.

.5 Provide custom dropped heavy duty front edges as shown.

2.4 SOLID SURFACING FABRICATIONS, COUNTERTOPS AND TRIM

.1 Division 6 Section Solid Surfacing Fabrications; Fabrications, countertops and trim installed by Section 06 61 16 – Solid Surfacing Fabrication.

2.5 PLASTIC LAMINATE COUNTERTOPS

.1 NAAWS Premium Grade.

.2 Plastic Laminate material and colour: Refer to Schedule of Finishes.

.3 Core material: Veneer core plywood for Wet Areas.

.4 Back splashes: butt joint per drawings, 102 mm high unless otherwise noted.

.5 Front edges: as per drawings.

2.6 ACCESSORIES AND AUXILIARY MATERIALS

.1 Adhesive: Type recommended by NAAWS to suit application.

.2 Fasteners: Size and type to suit application.

.3 Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; nickel plated finish in concealed locations and stainless steel finish in exposed locations.

.4 Concealed Joint Fasteners: Threaded steel.

.5 Tape: Aluminum foil, insulating and heat dissipating tape. Use butyl tape for isolating wood from masonry or cementitious materials.

.6 Stainless Steel Sheet (SST): ASTM A 666, Type 304 with AISI No. 4, brushed finish; 1 mm thick.

2.7 HARDWARE

.1 Wall Mounted Standards and Brackets:

.1 Basis of Design Manufacturer: Knape & Vogt Canada.

.2 Wall Mounted Standards: 22mm (7/8") wide x 17.5mm (11/16") high 12 gauge heavy-duty wall mounted standards with 50mm (2") slot adjustment, 914mm (3') long and capable of supporting 65 lbs./100 sq.ft.

.3 Brackets: 305mm (12") heavy-duty steel brackets with single, moulded nylon cam lock lever.

.4 Shelf Rests: Provide end, centre and front type shelf rests, complete with rubber cushions as required and for joining 2 shelves on one bracket.

.2 Hinges: Soft Close, full metal, nickel plated, concealed, spring loaded, soft close, 110 and 170 degree hinges.

.3 Drawer Slides: Electro-plated zinc screw mounted, heavy duty, full extension type with captive profile to eliminate side movement, soft close, positive in and out stops and, load capacity to suit drawer size with minimum static load rating of 27 kg for drawers 150 mm and less, and 40 kg for drawers over 150 mm in depth, lengths to suit application, side-mounted type.

.1 Product: Accuride Series 3832EC by Richelieu, or approved alternative.

.4 File Drawer Slides: Metafile System 'ZRM55030' by Richelieu or 'TandemBox Filing Drawer, 500mm deep' by Blum or approved equivalent.

.5 Drawer and Door Bumpers: Permanently fixed polyurethane type, clear colour.

.6 Pulls: D-shaped pulls, satin stainless steel, 100 mm long unless noted otherwise on drawings.

.7 Shelf Supports:

.1 Shelf Brackets: Formed steel brackets, formed for attachment with lugs; satin finish.

.2 Pilasters: Recessed pilasters and clips, zinc plated steel; Product: 255 and 256 by Knape & Vogt or approved equivalent.

.3 Pin shelf support: Nickel-plated steel pin shelf support, 5 mm diameter; Product: No. 282.38.708 by Hafele or approved equivalent.

.4 Glass shelf support: Galvanized steel glass pin shelf support with cap, 5 mm diameter; Product No. 2814.41.906 by Hafele or approved equivalent.

.8 Grommets: Plastic material for cut-outs, colour white;

.1 Grommet 1: 50 mm round; Product: TG Flip Top Series by Mockett, Round Grommet 76030 by Richelieu, or approved equivalent.

.9 Levelers:

.1 Provide levelers as indicated. Purpose made to suit condition. Manufactured by listed hardware manufacturer in this section.

.10 Casters: Provide plate-mounted swiveling casters as manufactured by listed hardware manufacturer in this section.

.1 Provide 3 casters without brake and 1 matching caster with brake.

.11 Under counter hooks: 'HJ-50' type 304, #4 finish stainless steel hook by Sugatsune.

.12 Cable Tray: Interconnecting, L-shaped plastic brackets; Product: WM27-90 by Mockett or approved equivalent.

2.8 FABRICATION AND WORKMANSHIP

.1 Work shall be executed by skilled carpenters under the supervision of a competent carpentry foreman. All items shall be shop assembled, insofar as is practical. Unless indicated otherwise comply with AWMAC Custom Grade requirements.

.2 Make thorough examination of drawings and details, check anchorage, interfacing with work of other sections and other factors influencing the installation of the work, and be fully cognizant of requirements.

.3 Finished woodwork shall be free from bruises, blemishes, mineral marks, knots, shakes and other defects and shall be selected for uniformity of colour, grain and texture.

.4 Be responsible for methods of construction and for ensuring that materials are rigidly and securely attached and will not be loosened by the work of other sections.

.5 Fabricate the work in a manner which will permit expansion and contraction of the materials without visible open joints.

.6 Mitre exposed corners; no end grain shall be visible in completed installation.

.7 Provide solid wood edging at exposed plywood edges.

.8 Provide wood mouldings and wainscot to profiles as indicated on drawings.

.9 Jointing of shop assembled work shall be by means of mortise and tenons, dowels, stub tenons, dovetails, dadoes, lock joints as applicable for the jointing condition.

.10 Accurately cut, mitre, fit and frame work together to produce tight hairline joints, rigidly secured together in a permanent manner using glue, blind screw fixing or nails. Use concealed glue blocks for additional strength where possible.

.11 Finished woodwork shall be in one piece wherever possible and all trim shall be in long lengths. Where jointing is necessary in the length, the joints between pieces shall be scarfed, glued and properly fastened. The material being jointed shall match reasonably well for grain and colour where natural finish is specified. Joints between lengths where paint finish is to be applied may be finger jointed in lieu of scarfing. Trim shall be accurately cut and mitred at all corners, glued and properly fastened.

.12 Machine dressed work shall be properly machine using sharp cutters, the finished work shall be free from drag, feathers, slivers or roughness of any kind. Remove machine marks by sanding.

.13 Finished woodwork shall be carefully hand sanded after installation to remove roughness and planer marks. Sanding shall be done with the grain of the wood and finished with fine grit paper to leave a smooth scratch-free surface suitable to receive the paint or natural finishes to be applied over as specified in Section 09 90 00 – Painting.

.14 Nail heads in the finished surfaces shall be set with straight shank nail sets. Screw and bolt heads in finished surfaces shall be let into the work and capped with edge grain wood caps dressed and finished flush.

.15 Provide cutouts for sinks, fixtures, fittings, inserts, outlet boxes, services, other mechanical and electrical items and appliances. Round corners, and chamfer edges. Where items for cutouts butt to underside or back of finished surface, finish exposed edge to match face. Where item covers cutout, and at all concealed cut edges of core material, apply uniform coating of seal to cut edges.

.16 The finished work shall be of a high quality, with all corners having exact angles to ensure no swerve or twisting. All bends, crimps or angle parts shall be produced by professional equipment and tools for this purpose and if long runs or repeats are required, such shall be produced in the shop, or have proper equipment on site.

.17 Plastic Laminate Covered Components:

.1 Meet requirements of CAN3-A172, Appendix A.

.2 Bond plastic laminate to core with adhesive using pressure. Provide balanced construction with plastic laminate face sheet on exposed sides of core and backer/liner sheet. Finish drawers with liner sheet on both sides of core for balanced construction.

.3 Unless otherwise detailed, provide 19mm (3/4") thick core.

.4 Apply plastic laminate to core material in accordance with adhesive manufacturer's instructions. Provide same core and laminate profiles to provide continuous support and bond over entire surface.

.5 Use continuous lengths up to 2439mm (8'). Keep joints 610mm (2') from cutouts and in locations indicated on reviewed shop drawings.

.6 Locate joints, where required at 2439mm to 3048mm (8' to 10') O.C. At L-shaped corners mitre plastic laminate, to the outside corner. Accurately fit members together to provide tight and flush butt joints, in true planes. Provide 6mm (1/4") blind spline and approved type draw bolts; one draw bolt for widths up to 150mm (6") at maximum 457mm (18") centres for widths exceeding 150mm (6"). Colour-match adjoining units.

.7 Form shaped profiles and bends using postforming grade laminate to laminate manufacturer's instructions.

.8 Where curved or bent surfaces are required for counters, backsplashes and other areas, use postforming laminate.

.9 Self-edge straight-line-edging with general purpose laminate and radius corners with postforming laminate, of same colour and finish as facing sheet, to cover exposed edges of core material. Apply with same adhesive as facing sheet. Chamfer edges uniformly at approximately 20 deg using machine router. Do not mitre laminate edges.

.10 Fabricate horizontal wearing surfaces including counters, shelves, both sides of removable shelves, cabinet doors and drawer fronts, of general purpose laminate except where postforming is required.

.11 Use general purpose laminate for exposed vertical surfaces except where otherwise specified or indicated.

.12 Apply plastic laminate backing sheet to reverse side of core of plastic laminate finished work including under counter tops and concealed portions of plastic laminate faced work. Provide backing sheet of specified minimum thickness, increased as required to compensate stresses caused by facing sheet.

.13 Apply laminated plastic liner sheet to interior of cabinetry unless indicated otherwise.

.14 Assemble work, true and square. Arrange adjacent parts of continuous laminate work to match in colour and pattern.

2.9 MOISTURE CONTENT

.1 Moisture content of interior woodwork shall be between 8% and 12%.

2.10 FINISHES

.1 Finishes shall match approved finished samples of wood treatment submitted by this section for each species of wood required. Wood items provided under this section shall be finished as part of the work of this section.

.2 Apply stain to items where scheduled, indicated or as directed Contract Administrator, providing uniform required stain colour(s).

.3 Provide finishes as indicated on drawings and scheduled, in accordance with requirements of Section 09 90 00 – Painting.

.4 Shop Finishing:

.1 Factory finish all millwork to NAAWS Premium standards. No field finishing permitted except for minor retouching.

.1 Finishing of Concealed Areas and Back Priming: Apply two coats of sealer to concealed cabinets interiors and backs.

3 Execution

3.1 EXAMINATION

.1 Inspect available spaces and check surfaces over which the work of this section is dependent for any irregularities detrimental to the application and performance of the work. Notify Contract Administrator in writing of all conditions which are at variance with those on the Contract Documents and/or detrimental to the proper and timely installation of the work of this section. The decision regarding correct measures shall be obtained from the Contract Administrator prior to proceeding with the affected work.

.2 Check humidity in building with moisture reading instruments if doubt exists that building is sufficiently dry and ready to receive millwork. Do not proceed until unsatisfactory conditions are corrected.

.3 Commencement of work indicates acceptance of surfaces and conditions.

.4 Verify existing conditions before starting work.

.5 Verify adequacy of backing and support framing.

.6 Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION - GENERAL

.1 Install Work in accordance with NAAWS Premium Grade.

.2 Set and secure casework in place; rigid, plumb, and level. Provide anchoring to conform to seismic requirements.

.3 Use fixture attachments in concealed locations for wall mounted components.

.4 Use concealed joint fasteners to align and secure adjoining cabinet units and counter tops.

.5 Carefully scribe casework abutting other components, with maximum gaps of 1 mm. Do not use additional overlay trim for this purpose.

.6 Secure cabinet counter bases to floor using appropriate angles and anchorages.

.7 Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

.8 Isolate wood members in contact with masonry or cementitious construction with butyl tape.

.9 At junctions of counter and back splash and at junctions of cabinets and adjacent wall finishes, apply small bead of clear silicone sealant.

.10 Provide and fit in place all furring, strapping, battens, grounds and blocking required to provide adequate properly placed fixing for all finish carpentry work and as required for the work of other sections.

.11 Refer to drawings and coordinate with drywall, the painting and floor covering sections to establish sequence of installation or execution of each others' work. Pay particular attention to areas where materials are supplied by others and installed under this Contract.

.12 All nails where their use is permitted, shall be long enough so that at least half their length penetrates into the second member. Splitting of wood members shall be minimized by staggering the nails in the direction of the grain and by keeping nails well in from edges.

.13 Unless otherwise permitted by Contract Administrator, fasten finish carpentry components in concealed manner.

.14 Plastic laminate work shall be free of cracks and chipped or broken edges. Replace damaged components.

.15 Fitments shall be installed level, plumb and true and complete in all respects.

.16 Fit small scribe moulds of same material as fitment to hide voids at junction of fitment to fitment and fitment to walls, partitions, ceilings, furrings.

.17 Provide and install all pass-thru doors, cable entry plugs, computer paper feed slot guides, casters, wall mounted standards with brackets and accessories as indicated on drawings, secure, plumb, level and true to line to adjacent surfaces and items.

3.3 PRIMING

.1 Immediately in instances where primed work is cut (as for fitting), a coat of primer shall be applied to the resulting raw surfaces.

3.4 INSTALLATION - CABINET HARDWARE

.1 Install cabinet hardware in shop wherever possible.

.2 Install cabinet hardware secure, plumb, level, true to line, and in accordance with hardware manufacturers' instructions.

.3 Cut and fit to finish carpentry and millwork for proper installation and operation of cabinet hardware.

.4 Size cutouts so that hardware item completely covers cutouts.

.5 Adjust and lubricate cabinet hardware as required for smooth and efficient operation without binding.

3.5 ADJUSTING

.1 Test installed work for rigidity and ability to support loads.

.2 Adjust moving or operating parts to function smoothly and correctly.

3.6 CLEANING

.1 Clean installed work.

.2 Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SECTION INCLUDES

.1 Composite quartz surfacing fabrications (CQS)

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.3 ANSI ICPA SS1 Performance Standard for Solid Surface Materials.

.4 CAN/ULC S102 Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS FOR REVIEW

.1 Shop Drawings: Indicate all dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.

.2 Samples: Submit two 50 x 50 mm samples of each colour and finish.

.3 Sustainable Design Submittals:

.1 Sustainability Characteristics: Submit products meet following LEED® performance criteria:

.1 MRc4: Provide Product with maximum pre-consumer and post-consumer recycled content available.

.2 MRc5: Provide Product with regional content.

.3 EQc4.1: Provide adhesives and sealants with VOC quantities lower than stated in SCAQMD Rule 1168. Ensure VOC quantities for sealants do not exceed 250 g/l under any circumstances.

1.5 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: Submit manufacturer's instructions for care and maintenance of solid surface materials including repair instructions.

1.6 QUALITY ASSURANCE

.1 Fabricator/Installer Qualifications: Company specializing in performing the work of this Section with minimum five (5) years' experience and certified by the Manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Do not deliver components to site until cabinetry or substrates are ready for installation. Store materials indoors prior to installation.

1.8 WARRANTY

.1 Provide ten (10) year manufacturer warranty against defects in materials and workmanship under normal usage. Warranty shall provide for all material and labour to repair or replace defective materials.

2 Products

2.1 MANUFACTURERS

.1 Subject to conformance with the requirements of this Section provide product by manufacturer named as the basis-of-design or approved equivalent product by an acceptable manufacturer.

.2 Basis of Design: Refer to Schedule of Finishes.

2.2 MATERIAL

.1 Solid Quartz Countertops (CQS): Solid quartz agglomerate sheets consisting of min 90% crushed quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1.

.1 Colours: Refer to Section 09 06 00 Finishes Schedule.

2.3 ACCESSORIES

.1 Joint adhesive: Manufacturer's recommended adhesive designed to create chemically bonded, inconspicuous, non-porous joints.

.2 Panel Adhesive: Manufacturer’s standard neoprene-based panel adhesive meeting ANSI A136.1-1967, UL listed.

.3 Sealant: Mildew-resistant, FDA/UL recognized silicone sealant in colour matching or clear formulations as specified.

2.4 FABRICATION

.1 Fabrications to be performed by a Manufacturer Certified fabricator/installer.

.2 Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and Manufacturer's requirements. (Technical Bulletin: CTDC-117)

.3 Form joints between components using manufacturer's standard joint adhesive. Joints shall be inconspicuous in appearance and without voids. Attach 50mm wide reinforcing strip of solid surface material under each joint. (Technical Bulletins: CTDC-124, 129, 134)

.4 Provide holes and cutouts for plumbing and bath accessories as indicated on the drawings.

.5 Rout and finish component edges to a smooth, uniform finish. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

.6 Finish: All surfaces shall have uniform finish. (Technical Bulletins: CTDC-100, 123, 132)

.1 Satin.

.7 Thermoforming: Comply with forming data from manufacturer. (Technical Bulletin CTDC-110)

.1 Construct matching molds of plywood to form component shape.

.2 Form pieces to shape prior to seaming and joining.

.3 Cut pieces larger than finished dimensions. Sand edges. Remove all nicks and scratches.

.4 Heat entire component uniformly between 135-163°C during forming.

.5 Prevent blistering, whitening and cracking during forming.

.8 Cove backsplashes: Where indicated, fabricate 13mm radius cove at intersection of counters and backsplashes. Form backsplashes using 13mm material. Fabricate in shop or field. (Technical Bulletin: CTDC-112)

3 Execution

3.1 INSTALLATION

.1 Install components plumb and level, in accordance with approved shop drawings and product installation details.

.2 Form field joints using Manufacturer's recommended adhesive, with joints inconspicuous in finished work. Keep components and hands clean when making joints.

.3 Provide backsplashes where indicated on the drawings. Adhere to countertops using Manufacturer's standard colour-matched silicone sealant.

.4 Keep components and hands clean during installation. Remove adhesives, sealants and other stains. Components shall be clean on Date of Substantial Completion.

.5 Make plumbing connections to sinks in accordance with Mechanical.

.6 Rigidly anchor to substrate to prevent misalignment.

3.2 TOLERANCES

.1 Variation in component size: ± 3mm.

.2 Location of openings: ± 3mm from indicated location.

3.3 PROTECTION

.1 Protect completed installation from damage with heavy kraft paper cardboard until date of final inspection.

3.4 ADJUSTING AND CLEANING

.1 Repair damaged and defective countertops to eliminate functional and visual defects; where not possible to repair, replace. Adjust joinery for uniform appearance.

.2 Remove all excess adhesives, sealants and other contaminates from installation and all adjacent surfaces. Clean countertops on exposed and semi-exposed surfaces.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of a hot applied waterproofing membrane system.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 QUALITY ASSURANCE

.1 Installer Qualifications: Trained and approved by the manufacturer and having a minimum three years' experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.

.1 Qualifications include having the necessary experience, staff, and training to install manufacturer's products. Manufacturer's willingness to sell its products to installers does not in itself confer qualification on installer.

.2 Pre-Installation Meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.1 Review construction schedule and verify availability of materials, installer's personnel, equipment, and facilities necessary to make progress and avoid delays.

.3 Manufacturer's Site Inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.4 Source Limitations: Obtain each type of product from a single manufacturer.

.5 Sample Installation: Provide a 3 m x 3 m (10' X 10') representative sample installation of work of this Section on site at location directed by Contract Administrator to verify selections made under sample submittals and to set quality standards for installation. Remove rejected sample installation and provide additional sample installations until acceptance is given. Do not commence work until sample installation has been accepted. Accepted sample installation may form part of the completed Work if undisturbed at time of Substantial Performance.

.1 Acceptance of sample installations does not constitute approval of deviations from the Contract Documents contained in sample installations unless such deviations are specifically approved by Contract Administrator in writing.

.6 Testing of Substrate: Test substrate after preparation for Product installation is complete and filler, patching or levelling compound is fully cured. Conduct testing on substrate free of

sealer, oil, grease and other agents detrimental to the test and the installation of the Products. Locate test sites to cover representative installation areas. Do not proceed with work when the test results do not conform to the specified allowable.

.1 Surface Moisture Content: Maximum 4%, tested by moisture meter. Do one test for every 46 sq.m. (500 sq.ft.) or fraction thereof.

.2 Surface Temperature: Minimum 3 degree C above the measured dew point.

1.5 PERFORMANCE REQUIREMENTS

.1 Provide waterproofing membrane that prevents the passage of water.

1.6 SUBMITTALS

.1 Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties.

.2 Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions.

.3 Samples: Duplicate samples for the following products:

.1 300 mm x 300 mm (12” x 12”) square of flashing sheet.

.2 100 mm x 100 mm (4” x 4”) square of each type of drainage panel.

.4 Sustainable Design Submittals:

.1 LEED Submittals: Co-ordinate submittals, submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Recycled Content: provide listing of products incorporating recycled content. Include details of percentages of post-consumer and pre-consumer recycled content for materials and products. Indicate material and product costs.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20% of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver liquid materials to Project site in original containers with seals unbroken, labelled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

.2 Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

.3 Remove and replace liquid materials that cannot be applied within their stated shelf life.

.4 Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

.1 Environmental Limitations: Apply work within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below minus 18 degree C.

.1 Do not apply waterproofing in snow, rain, fog, or mist.

.2 Maintain adequate ventilation during application and curing of waterproofing materials.

1.9 WARRANTY

.1 Manufacturer's Warranty: Written non-prorated and without monetary limitation system warranty, signed by waterproofing manufacturer agreeing to repair or replace waterproofing and sheet flashings that do not comply with requirements or that do not remain watertight within 10 years after date of Substantial Performance.

.1 Warranty does not include failure of waterproofing due to failure of substrate prepared and treated in accordance with requirements or formation of new joints and cracks in substrate that exceed 3 mm (1/8") in width.

.2 Warranty includes removing and reinstalling work of this Section and overlaying construction.

.2 Installer's Warranty: Written waterproofing Installer's warranty, signed by Installer, covering Work of this Section, for warranty period of two years after date of Substantial Performance.

.1 Warranty includes removing and reinstalling work of this Section and overlaying construction.

2 Products

2.1 MATERIALS

.1 General: Provide waterproofing materials recommended by manufacturer to be compatible with one another and able to develop bond to substrate under conditions of service and application, as demonstrated by waterproofing manufacturer based on testing and field experience.

.1 Produce waterproofing materials suitable for application to vertical, horizontal, and sloped substrates, as applicable.

.2 Membrane: CAN/CGSB-37.50, single-component; 100 percent solids; hot fluid applied, rubberized asphalt. Subject to compliance with requirements, provide one of the following products:

.1 Monolithic Membrane 6125 by American Hydrotech of Sika Company.

.2 TREMproof 6100 by Tremco Canada`.

.3 790-11 Hot Applied Rubberized Asphalt Waterproofing by Henry Canada.

.3 Primer: CGSB 37-GP-9, compatible with membrane and approved by membrane manufacturer.

.4 Modified Bituminous Flashing Sheet: If required by membrane manufacturer for warranty, SBS modified bituminous sheet, 4 mm (160 mil) thick, woven or nonwoven polyester or glass fiber reinforced; suitable for application method specified; granular surfaced.

.5 Sealants and Accessories: Waterproofing manufacturer's recommended sealants and accessories.

.6 Reinforcing Fabric: Manufacturer's recommended spun-bonded polyester fabric.

.7 Separation Sheet: Polyethylene sheet, minimum 0.10 mm (4 mils) thick.

.8 Protection Board: Semi-rigid sheets of glass fibre or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:

.1 Thickness: 3 mm (1/8") nominal for vertical applications; 6 mm (1/4") nominal elsewhere.

.2 Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for type of protection board.

.9 Insulations: To requirements of Division 7 Building Insulation section.

2.2 DRAINAGE PANELS

.1 Manufactured sheets of composite drainage panels consisting of a woven geotextile facing with an apparent opening size not exceeding 0.43 mm (No.40) sieve laminated to 1 side of a 3-dimensional, non-biodegradable, moulded plastic sheet drainage core, Terradrain 900 by Terrafix Geosynthetics Inc., Mirafi G 100 Series by TenCate Solmax, or J-DRain 700 by JDR Enterprises Inc.

3 Execution

3.1 EXAMINATION

.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

.1 Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Clean and prepare substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

.2 Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

.3 Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

.4 Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film forming coatings from concrete.

.5 Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

3.3 JOINTS, CRACKS, AND TERMINATIONS

.1 Prepare and treat substrates to receive work, in accordance with CAN/CGSB-37.51 and waterproofing system manufacturer's written instructions.

.2 Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt.

.3 Embed reinforcing fabric into a layer of hot, rubberized asphalt. Extend reinforcing fabric a minimum of 150 mm (6”) on each side of joints and cracks and beyond deck drains, corners, and penetrations.

.4 At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric flashing sheet extended a minimum of 150 mm (6”) on each side of joints and adhere to substrates in a layer of hot, rubberized asphalt.

3.4 FLASHING INSTALLATION

.1 Install flashing sheets at terminations of waterproofing membrane in accordance with CAN/CGSB-37.51, and waterproofing system manufacturer's written instructions.

.2 Prime substrate with asphalt primer.

.3 Install modified-bituminous flashing sheet and adhere to substrate in a layer of hot, rubberized asphalt.

.4 Overlap flashing sheet, shingle style, minimum 300 mm (12”) with foundation waterproofing.

.5 Install termination bars and mechanically fasten flashing sheet at terminations and perimeter of waterproofing.

3.5 MEMBRANE APPLICATION

.1 Apply work in accordance with CAN/CGSB-37.51, and manufacturer's written instructions.

.2 Heat rubberized asphalt in an oil or air jacketed melter with mechanical agitator specifically designed for heating rubberized-asphalt waterproofing.

.3 Apply primer, at manufacturer's recommended rate, over prepared substrate and allow to dry.

.4 Reinforced Membrane: Spread hot fluid applied, rubberized asphalt to a thickness of 2.3 mm (90 mils); embed reinforcing fabric, overlapping sheets 50 mm (2”), and spread another 3.2 mm (125 mils) thick layer to provide a uniform, reinforced, seamless membrane 5.5 mm (215 mils) thick.

.5 Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.

.6 Cover waterproofing with separation sheet with overlapped joints while rubberized asphalt is still hot and before membrane is subject to traffic.

.1 Install protection board with overlapped joints over separation sheet.

3.6 DRAINAGE PANEL INSTALLATION

.1 Place and secure drainage panels in accordance with manufacturer's written instructions. Lap edges and ends of geotextile fabric to maintain continuity. Protect installed drainage panels during subsequent construction.

.1 For vertical applications, install board insulation used as a protection board before installing drainage panels.

3.7 FIELD QUALITY CONTROL

.1 Flood Testing: Flood test each deck area for leaks, after completing waterproofing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

.1 Limit water depth to not exceed load capacity of deck. Flood to an average depth of 50 mm (2”) with a minimum depth of 25 mm (1”) and not exceeding a depth of 75 mm (3”). Maintain 50 mm (2”) of clearance from top of sheet flashings.

.2 Flood each area for 24 hours.

.3 After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

.4 Engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.

3.8 CURING, PROTECTING, AND CLEANING

.1 Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.

.2 Protect waterproofing from damage and wear during remainder of construction period.

.3 Protect installed board insulation and drainage panels from damage due to ultraviolet light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

.4 Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of the following:

.1 Foundation Insulation Board

.2 Concrete Faced Perimeter Insulation Board

.3 Mineral Wool Semi Rigid Insulation

.4 Mineral Wool Batt Insulation

.5 Acoustic Insulation

1.3 **RELATED REQUIREMENTS**

.1 Coordinate with Work of other Sections having a direct bearing on Work of this Section.

1.4 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering

.3 American Society for Testing and Materials (ASTM):

.1 ASTM D1621, Standard Test Method for Compressive Properties of Rigid Cellular Plastics

.2 ASTM D2842, Standard Test Method for Water Absorption of Rigid Cellular Plastics

.4 Canadian General Standards Board (CGSB):

.1 CGSB 71-GP-24M, Adhesive, Flexible for Bonding Cellular Polystyrene Insulation

.2 CAN/CGSB-37.5, Cutback Asphalt Plastic Cement

.5 Canadian Standards Association (CSA):

.1 CSA A123.3, Asphalt Saturated Organic Roofing Felt

1.5 SUBMITTALS

.1 Product Data: Provide product description, insulation properties, and preparation requirements.

.2 Sustainable Design Submittals:

.1 LEED Submittals: Co-ordinate submittals requirements, submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Recycled Content: provide listing of products incorporating recycled content. Include details of percentages of post-consumer and pre-consumer recycled content for materials and products. Indicate material and product costs.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20% of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project.

.3 GREENGUARD Submittals: submit documentation of Indoor Air Quality Certified material.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Store insulation materials in dry areas, protected from wetting, sunlight and traffic. Store insulation board flat, on a flat surface, and to prevent edge damage and placing of materials on top of stored boards.

.2 Ensure that insulation board and adhesives are stored at a minimum temperature of 4 deg C for twelve (12) hours before installation, and that freezable adhesives are stored only at temperatures above 0 deg C at all times.

2 Products

2.1 MATERIALS

.1 Foundation Insulation Board:

.1 Extruded expanded polystyrene meeting CAN/ULC S701, Type 4, minimum RSI value of 0.88 per 25 mm thickness (R value of 5 per inch). Minimum compressive strength of 206 kPa.

.1 Styrofoam brand SM, by Dupont Canada.

.2 Foamular NGX C-300, by Owens-Corning Canada LP.

.2 Concrete Faced Perimeter Insulation Board:

.1 Perimeter Foundation Insulation: Extruded polystyrene board to ASTM C578 (CAN/ULC-S701) Type IV, rigid, closed cell, with integral high density skin, complete with integral 8mm (5/16”) thick latex-modified concrete facing.

.2 Board Size: 610mm x 1220mm x 59mm (24” x 48” x 2-5/16”).

.3 Edges: Tongue and groove sides, square edge ends.

.4 Thermal Resistance (ASTM C 518): Long term aged R-value of 5/1” (0.03 sm K/W / 1mm).

.5 Products:

.1 WallGUARD Concrete Faced Insulated Perimeter Wall Panels by T. Clear Corp.

.2 Concrete Faced Insulation Wall Panels (CFI) by Tech-Crete Processors Ltd.

.3 Semi-Rigid Insulation: Mineral Wool Board Insulation for exterior wall cavity behind cladding, CAN/ULC-S702 Type 1 or ASTM C612 Type IVB, mineral rock or slag fibre semi-rigid board, conforming to the following:

.1 Board Density: 65 kg/cu m.

.2 Water Vapour Permeance: 1555 ng/Pa s.sq. m.

.3 Minimum Thermal Resistance: RSI of 0.75 per 25.4 mm thickness.

.4 Board Size: 600 x length to suit space.

.5 Board Thickness: As indicated.

.6 Facing:

.1 Unfaced unless otherwise noted.

.2 Where Black facer is indicated, provide “32# Manniglas -1882 Black” factory applied facer by Lydall or approved equivalent.

.7 Board Edges: Square.

.8 Flame/Smoke Properties: 0 / 0, in accordance with CAN/ULC-S102.

.9 Acceptable Products:

.1 CavityRock manufactured by Rockwool,

.2 Rainbarrier 45 manufactured by Thermafiber.

.4 Semi-Rigid Insulation: Mineral Wool Board Insulation for Curtain Wall spandrel panels, CAN/ULC-S702 Type 1 or ASTM C612 Type IVB, mineral rock or slag fibre semi-rigid board, conforming to the following:

.1 Board Density: 56 kg/cu m.

.2 Water Vapour Permeance: 1.807 ng/Pa s.sq. m.

.3 Minimum Thermal Resistance: RSI of 0.74.

.4 Board Size: 600 x length to suit space.

.5 Board Thickness: As indicated.

.6 Facing: Unfaced.

.7 Board Edges: Square.

.8 Flame/Smoke Properties: 0 / 0, in accordance with CAN/ULC-S102.

.9 Acceptable Products:

.1 Curtain Rock manufactured by Rockwool,

.2 MinWool Curtainwall by Johns Manville

.3 Versaboard manufactured by Thermafiber,

.5 Thermal Batt Insulation: Mineral wool batt insulation, CAN/ULC-S702 Type 1, density 32 kg/m^3 (2 lb/ft^3) fibre, thickness and thermal resistance value as indicated.

.1 Comfortbatt by Rockwool.

.2 Ultrabatt by Thermafiber,

.3 TempControl Batts by Johns Manville.

.6 Acoustic Insulation: CAN/ULC-S702 or ASTM C665; preformed glass or mineral fibre, thickness as indicated.

.1 Acoustic Partition Insulation: Friction fit type, unfaced, width to suit stud spacing:

.1 Glass Fibre Batt:

.1 QuietZone PINK Next Gen FiberGlas Insulation by Owens Corning.

.2 Sound-Shield by Johns Manville.

.2 Mineral Wool Batt:

.1 AFB Batts by Rockwool.

.2 SAFB insulation batt by Johns Manville.

.3 SAFB by Thermafiber.

2.2 ACCESSORIES

.1 Insulation Fasteners:

.1 Mechanical Fasteners: High quality, impact resistant plastic fastener system specifically designed for installation of board insulation materials; 38mm (1-1/2") diameter, shaft length to suit insulation thickness and hot dipped galvanized fastener to suit substrate.

.2 Insulation Clips: Impale type, perforated 50mm x 50mm (2" x 2") cold rolled carbon steel 1mm (1/32") core metal thickness, adhesive back; 1.6mm (1/16") diameter annealed steel wire spindle, length to suit insulation, 25mm (1") diameter self locking washers.

.3 Perimeter Insulation Fasteners: Concrete faced insulation manufacturer's standard concealed fasteners with groove mounting plate and fastening spline.

.2 Adhesive:

.1 Trowelable Polystyrene Insulation Adhesive: Trowel consistency, synthetic rubber based insulation adhesive compatible with polystyrene insulation in accordance with CGSB 71GP24M; suitable for application to temperature of -10 deg C or lower, as approved by insulation board supplier.

.3 Felt Slip Sheet: No. 15 asphalt saturated, organic, unperforated felt conforming to CSA A123.3.

.4 Slip Sheet Mastic: Cut back asphalt plastic cement conforming to CAN/CGSB-37.5.

.5 Vapour Barrier:

.1 10 mils thick clear polyethylene sheet conforming to CAN/CGSB-51.34.

.6 Polyethylene Adhesive Tape:

.1 Scotch Brand No.483 manufactured by 3M Company.

.7 Foam Insulation: CFC free polyurethane foam-in-place moisture cure sealant insulation, 16 kg/cu.m. to 32 kg/cu.m. density; injected from prepackaged pressurized containers.

.1 Acceptable Products:

.1 Enerfoam by Dupont Canada

.2 IPF AllWeather Pro by Rivenco Industries Ltd.

3 Execution

3.1 EXAMINATION

.1 Before commencing work, ensure that all surfaces to which perimeter insulation board is applied are clean, reasonably smooth with no abrupt changes in plane, free of grease, and with protruding fins of mortar or concrete removed, and that the surfaces are otherwise acceptable for insulation application as specified.

3.2 PREPARATION

.1 Clean substrates of substances harmful to insulations; remove projections that interfere with insulation attachment.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

.1 Install insulation and accessories in accordance with manufacturer's written instructions applicable to products and application indicated and as follows:

.1 Use insulation that is undamaged, dry, and unsoiled.

.2 Maintain continuous thermal insulation, vapour barrier and air tightness for building spaces and elements, and as follows:

.1 Saw cut and trim insulation neatly to fit spaces; fill voids with foamedinplace insulation compatible with installed insulation.

.2 Butt edges and ends tight

.3 Fit insulation tight against mechanical, electrical and other items protruding through the plane of insulation

.4 Use insulation free of broken or chipped edges

.5 Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise specifically shown or required to make up total thickness

.6 Fit insulation firmly against substrate using mechanical fasteners spaced in accordance with manufacturers recommended spacing and pattern; in addition, adhere insulation to uneven substrate surfaces and provide additional fasteners to eliminate air spaces between insulation and substrate

.7 Mechanically fasten insulation boards 50mm (2”) in from edges at 305mm (12”) centers

.2 Leave insulation joints unbonded over line of expansion and control joints; bond a continuous 150mm (6”) wide strip of primary vapour membrane over expansion and control joints using compatible adhesive

.3 Protect insulation from damage until it is covered; replace any broken, sunburned, crushed or dented insulation immediately prior to covering; coordinate with backfilling operations

.4 Board Insulation: Install board insulation to vertical surfaces with adhesive applied in accordance with manufacturer's written instructions, and as follows:

.1 Exterior Application: Extend boards as indicated on Drawings to top of footing, installed on exterior face of perimeter foundation wall.

.2 Apply adhesive to the substrate by the "dab" method not less than 9.5mm x 19m (3/8” x 3/4") size at 150mm (6”) centers; bed the insulation in the adhesive before the adhesive loses its tack or skins over.

.3 Protect below grade insulation on vertical surfaces from damage during backfilling by applying protection board; set in adhesive according to insulation manufacturer's written instructions.

.5 Concrete Faced Perimeter Insulation:

.1 Layout concrete-faced insulation boards to maximize board sizes. Do not use boards less than 152mm (6”) wide.

.2 Install concrete faced insulation board system in orientation as indicated or to maximize full sheets. Complete with fastening clips and cap flashing in accordance with manufacturer's installation guidelines.

.6 Cavity Wall Insulation: Fit courses of insulation between wall ties and other confining obstructions in cavity; butt edges tightly in vertical and horizontal directions and as follows:

.1 Install cavity insulation with a tight fit to substrate materials, provide adhesive and additional fasteners where uneven substrates cause air spaces behind insulation;

apply adhesive to substrate in a continuous film not less than 3mm (1/8") thick when wet and bed the insulation into adhesive before adhesive loses its tack or skins-over.

.2 Apply insulation fasteners using a minimum of six (6) fasteners in two rows located near the centre of the board along the narrow dimension and near the third points along the long dimension; secure boards with two clips at the centre where both dimensions are less than 610mm (24").

.3 Coordinate application of cavity wall insulation with installation of masonry ties and anchors specified in Section 04 22 00 – Concrete Masonry Units.

.4 Apply sheet membrane vapour retarder behind Zbars prior to installation of insulation between Zbars supporting preformed metal cladding.

.5 Install insulation clips to walls before sheet membrane air barriers are applied.

.7 Semi-Rigid Insulation: Mineral Wool Board Insulation for Curtain Wall spandrel panels

.1 Install curtain wall in accordance with curtain wall system manufacture recommendations, and as indicated in Section 08 44 13 - Glazed Aluminum Curtain Wall.

3.4 BATT INSULATION

.1 Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation.

.2 Metal Framing: Place membrane air barrier on warm side of insulation; lap and seal sheet air barrier joints over member face.

.3 Tape seal tears or cuts in membrane air barrier.

.4 Install continuous vapour barrier, overlapping adjacent surfaces including self-joints a minimum of 50mm (2") and seal with specified tape. Applications to form a complete vapour seal.

3.5 PROTECTION

.1 Protect installed board insulation from damage due to harmful weather exposures, physical abuse, and other causes.

.2 Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of self-adhered air and vapour membranes that prevent exfiltration and infiltration between interior and exterior of building through wall and at transition construction.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 American Society for Testing of Materials (ASTM):

.1 ASTM E96/E96M-10, Standard Test Methods for Water Vapour Transmission of Materials

.2 ASTM E2178-11, Standard Test Method for Air Permeance of Building Materials

1.4 DEFINITIONS

.1 Air Vapour Barrier Material: A primary element that provides a continuous barrier to the movement of air.

.2 Air Vapour Barrier Accessory: A transitional component of the Air Vapour Barrier that provides continuity.

.3 Air Vapour Barrier Assembly: The collection of Air Vapour Barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Conference:

.1 Convene a pre-installation conference two (2) weeks prior to commencing work of this section. Require attendance of parties directly affecting work of this section, including, but not limited to, the City's representative, Contract Administrator, Contractor, air and vapour barrier membrane contractor, air and vapour barrier membrane manufacturer's representative and substrate installer.

.2 Contact Contract Administrator two (2) weeks prior to pre-installation conference to confirm schedule.

.3 Review preparation and installation procedures and co-ordinating and scheduling required with related work.

.4 Record discussions of conference and decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. Review foreseeable methods and procedures related to the vapour permeable air barrier membrane, including the following:

.1 Tour, inspect and discuss condition of substrate, penetrations and preparatory work performed by other trades.

.2 Review surface preparation, minimum curing period and installation procedures.

.3 Review special details and flashings.

.4 Review required submittals, both completed and yet to be completed.

.5 Review and finalize construction schedule related to work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.

.6 Review required inspections, testing, protection and repair procedures.

.7 Review weather and forecasted weather conditions, and procedures for coping with unfavourable conditions.

.2 Coordination: Coordinate interface of membranes specified in this Section with adjacent systems to ensure continuity of system and that junctions between various components are effectively sealed; verify with manufacturers and installers for installation procedures of materials incorporated into air and vapour membrane elements including membranes, transitions, coatings and sealants and continuity with roofing membrane.

1.6 SUBMITTALS

.1 Action Submittals:

.1 Product Data: Submit manufacturer's product literature, and installation instructions required for complete and proper installation of air and vapour retarder elements including membranes, primers, fasteners, proprietary application equipment, etc.

.2 Samples: Submit representative sample of air and vapour membrane minimum 305mm x 305mm (12" x 12") with factory applied identification clearly visible.

.2 Safety Data Sheets:

.1 Submit WHMIS safety data sheets for inclusion with project record documents. Keep one copy of WHMIS safety data sheets on site for reference by workers.

.3 Sustainable Design Submittals:

.1 LEED Submittals: Co-ordinate submittals requirements, submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Recycled Content: provide listing of products incorporating recycled content. Include details of percentages of post-consumer and pre-consumer recycled content for materials and products. Indicate material and product costs.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20% of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project.

.3 GREENGUARD Submittals: submit documentation of Indoor Air Quality Certified material.

1.7 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Contract Administrator:

.1 Manufacturer: Obtain air and vapour membrane materials through one source from a single manufacturer or using materials from a secondary source that are acceptable to the manufacturer.

.2 Installer: Use an installation company that is acceptable to the manufacturer, using workers who are trained and approved by the membrane manufacturer having experience with projects of similar complexity and area.

1.8 ENVIRONMENTAL CONDITIONS

.1 Air and vapour barrier is not to be applied to surfaces that are either wet, oily, frosted, dirty or contaminated in any way.

.2 Ambient Conditions: Apply air and vapour membrane to substrate surfaces that are within manufacturer's installation temperature threshold range accounting for wind cooling and apparent temperature when actual temperature is approaching manufacturer's minimum temperature threshold.

.3 Air and vapour barrier is not to be applied over lightweight cast-in-place concrete containing high moisture or certain curing compounds. Cast-in-place concrete should be cured for a minimum of two weeks prior to application of air barrier membrane.

1.9 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries with construction schedule and arrange for proper storage areas.

.2 All materials are to be stored in a clean, dry and protected area in their original containers sealed and undamaged. Manufacturer's labels are to be easily visible and undamaged.

.3 Care and precaution are to be exercised by the applicator so as not to damage the work of other trades. Applicator is responsible to take all necessary precautions to protect work of other trades during application.

.4 In addition to the above, store modified bituminous sheet type air and vapour barrier membrane as follows:

.1 Store rolls of membrane on end, in vertical position without leaning with selvage end up.

.2 Store materials away from direct heat or open flame.

.3 For installation in cold weather, store rolls of membrane in heated storage trailer for minimum of 24 hours with the temperature kept at 21 deg C and remove for application with as little exposure as possible to low ambient temperatures.

.5 Provide portable fire extinguishers within easy access of torching applications.

1.10 WARRANTY

.1 Manufacturer's Warranty: Submit manufacturer's warranty stating that air and vapour membranes and accessories are free of defects and are manufactured to meet manufacturer's published physical properties and material specifications as of the date of product delivery.

.2 Installer's Warranty: Submit installers warranty stating that air and vapour membranes and accessories are installed in accordance with manufacturer's recommendations and that membrane, transitions and through-wall flashing membranes, primers, mastics, adhesives and sealants are sourced from one manufacturer.

2 Products

2.1 MATERIALS – GENERAL

.1 Source Limitations: Obtain primary air vapour barrier (AVB) materials and air vapour barrier accessories from single source from single manufacturer.

2.2 AIR AND VAPOUR BARRIER – SELF ADHESIVE SHEET MATERIALS

.1 Self-Adhesive Air Vapour Barrier Membrane: 1 mm (40 mils) thick modified bituminous composite sheet, regular and low temperature grade, and companion through wall flashing.

.1 Acceptable products:

.1 Blueskin SA LT by Henry Canada.

.2 Sopraseal Stick 1100T Winter Grade by Soprema.

.3 ExoAir 110LT by Tremco.

.4 Air Shield/Air Shield LT by W.R. Meadows Inc.

2.3 ACCESSORIES

.1 Accessories: Furnish auxiliary materials recommended by manufacturer for intended use and compatible with air vapour barrier (AVB) membrane.

.1 Flashing to counter flash metal flashings refer to Section 07 62 00 – Prefinished Metal Flashing and Trim.

.2 AVB Transition Strip: Peel and stick membrane to transition between membranes as recommended by membrane manufacture.

.3 Primer: If required and as recommended by membrane manufacture for approved substrate, VOC compliant.

.4 Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes by membrane manufacturer.

.5 Termination bars and fasteners: Galvanized steel, Stainless steel and stainless fasteners.

3 Execution

3.1 EXAMINATION

.1 Ensure that surfaces to receive air barrier membrane are dry, firm, suitable for bond, and free from dust, dirt, loose material, projections, ice, frost, slick, grease, oil or other matter detrimental to bond of sheet type air barrier membrane.

.2 Report surfaces left unacceptable by other trades in writing to the Contract Administrator before commencing installation.

.3 Co-ordinate work of this section with the work of other sections.

.4 Commencement of work of this section implies acceptance of surfaces and conditions.

3.2 PREPARATION

.1 Prepare surfaces in accordance with manufacturer's written requirements for type of substrate; free from voids, spalled areas, loose aggregates or sharp points; clean surfaces to remove contaminants that could affect bond such as grease or wax, dust, dirt and debris.

.2 Apply primer to substrates when required by manufacturer at rate recommended by manufacturer; cover primed substrates on same day, reapply primer when work cannot be completed on the same day.

3.3 INSTALLATION

.1 Install air and vapour barrier membranes in accordance with manufacturer's written requirements, using appropriate equipment and skilled workers and as follows:

.1 Transition Membranes: Connect air and vapour membranes to adjacent assemblies having pre-installed transition membranes; install transition membranes where required to maintain continuity of building envelope.

.2 Through Wall and Flexible Flashings: Install flexible membranes where required to maintain flow direction to divert water away from face of building envelope.

.2 Separate air and vapour barrier membranes from incompatible materials, and provide manufacturer's recommended transition materials required to maintain continuity of building envelope.

.3 Cut and tightly seal air and vapour barrier membrane around penetrations and protrusions to provide a continuous air barrier.

.4 Lap joints in air and vapour barrier membrane minimum of 75mm (3").

.5 Where masonry anchors and supports pass through air and vapour barrier membrane, ensure continuity of air and vapour barrier membrane by applying air barrier mastic all around/over masonry anchors.

.6 Prior to masonry being installed by Section 04 22 00 – Concrete Masonry Units, inspect air and vapour barrier membrane for punctures, misaligned seams and fishmouths. Apply additional layer of air and vapour barrier membrane over damaged/affected areas, extending membrane minimum of 152 mm (6") beyond damage in all directions.

3.4 SITE QUALITY CONTROL

.1 Allow access for review and inspection and testing of installed air and vapour barrier membrane, and repair of deficiencies before placement of insulation materials.

.2 Manufacturer's Site Services: Arrange for air and vapour barrier membrane manufacturer's technical personnel to review building envelope during installation.

.3 The City reserves the right to engage a testing firm to perform air and vapour barrier membrane testing to confirm performance of installed membranes and insulation systems. Testing will be performed when the building mechanical systems are balanced and operating; when building is occupied and climatic conditions are suitable for infrared thermographic scan of the building.

.4 Cooperate with testing agency; repair or replace air and vapour barrier membrane as directed by testing agency, at no additional cost to the City.

3.5 CLEANING AND PROTECTION

.1 Protection: Protect membrane as recommended by manufacturer from effects of long term exposure where membrane is open to the environment for prolonged time periods using opaque plastic sheets or tarpaulins; protect membrane from penetrations and damage by successive components of the Work; assign payment for repairs to responsible parties; make repairs in accordance with manufacturer's written instructions using original installers.

.2 Cleaning: Remove masking materials, debris, excess materials and equipment from site at completion of the work; conduct ongoing daily cleaning as directed by the Contractor; clean stains, drips or spills of coatings, sealants, mastic or primers visible on finished surfaces.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for prefinished metal cladding, complete with a system of girts, flashings and trims, using sheet metals and concealed fasteners.

.2 Provide specified system with labour, materials, and equipment required to fabricate and erect cladding including cutting and penetrations, accessories, flashings, trims and closures necessary for a complete installation.

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 American Architectural Manufacturers Association (AAMA):

.1 AAMA 605.2, Voluntary Specification for High Performance Coatings on Architectural Panels and Extrusions.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A653/A653M, Steel Sheet, ZincCoated (Galvanized) or ZincIron Alloy Coated (Galvannealed) by the HotDip Process, Physical (Structural) Quality.

.2 ASTM A755/A755M, Standard Specification for Steel Sheet, Metallic Coated by the HotDip Process and Prepainted by the CoilCoating Process for Exterior Exposed Building Products.

.4 Canadian Sheet Steel Building Institute (CSSBI):

.1 CSSBI 20M, Standard for Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications.

.2 CSSBI S8, Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.

.5 Canadian Standards Association (CSA):

.1 CSA CAN/CSA S16, Design of Steel Structures

.2 CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members

.6 Canadian General Standards Board (CGSB):

.1 CGSB 1.108, Bituminous Solvent Type Paint

.7 The Society for Protective Coatings (SSPC)

.1 SSPC Guide 14, Guide for the Repair of Imperfections in Galvanized, Organic, or Inorganic Zinc-Coated Steel Using Organic Zinc-Rich Coatings

.8 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 SUBMITTALS

.1 Submit manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to materials and finishes for each component and for total panel assemblies.

.2 Shop Drawings:

.1 Submit fully dimensioned shop drawings to Contract Administrator showing construction and anchorage of the wall assembly, including elevations, sections, details and interfacing with work of other Sections.

.2 No work of this Section shall be fabricated until shop drawings and all other related submittals, documentation, certifications and samples as required by this Section, have been reviewed by the Contract Administrator.

.3 Details shall indicate metal thicknesses, areas to be sealed and sealant materials, gaskets, type of joints, flashings, trim, finishes, fasteners and welds, all anchorage assemblies and components and erection details.

.4 Shop drawings shall bear the seal of an engineer registered to practice in the place of Work, employed by the preformed metal cladding manufacturer, and shall include complete design calculations for the system and documentation in regard to the reactions of the metal cladding due to thermal expansion and contraction, positive and negative wind pressure and assurance that the thermal movement and wind forces have sufficient attachments, supports, bracing and anchorage.

.3 Samples:

.1 Submit to the Contract Administrator for approval, samples of materials and components to be used in the system, prior to fabrication of work together with name of manufacturer and technical literature. Submit 305 mm x 305 mm (12" x 12") samples of metal, peel and stick membrane and Z-girts. Submit two (2) full size panels of metal cladding.

.4 Safety Data Sheets:

.1 Submit WHMIS safety data sheets for inclusion with project record documents. Keep one copy of WHMIS safety data sheets on Site for reference by workers.

.5 Sustainable Design Submittals:

.1 LEED Submittals: Co-ordinate submittals requirements, submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Recycled Content: provide listing of products incorporating recycled content. Include details of percentages of post-consumer and pre-consumer recycled content for materials and products. Indicate material and product costs.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20% of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Manufacturer and tradesmen executing the work of this Section shall have had a minimum five (5) years continuous Canadian experience in successful manufacture

and installation of work of type and quality shown and specified. Submit proof of experience upon Contract Administrator's request.

.2 Erection of preformed metal cladding systems shall be by workers especially trained and experienced in this type of work. Have a qualified representative at the job site to direct the work of this Section at all times.

.3 Retain a professional engineer, registered in the province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Document requirements including, but not limited to, the following:

.1 Seal and signature to shop drawings and design submittals requiring structural engineering.

.2 Field review of installed components.

.4 Conform to the requirements of the local Building Code, local by-laws and Authorities having jurisdiction.

1.6 PREINSTALLATION CONFERENCE

.1 Convene one (1) week before commencing Work of this Section to discuss expectations for fit and finish of wall system, quality of workmanship for installation of air/vapour retarders and insulation and relationship of wall system to adjacent components.

.2 Meeting shall be attended by the installer, manufacturer's representative, Contractor and the Contract Administrator.

.3 Manufacturer's representative shall also provide frequent inspection visits during the course of work of this Section to assure quality and competence of membrane installation and panel alignment

1.7 DESIGN REQUIREMENTS

.1 Maximum deflection not to exceed L/180 under system's own weight plus wind load (positive and negative) loads acting normal to the plane in accordance with the Building Code Climatic Data, wind load 1:50 years.

.2 Design sheet cladding to span continuously over at least four structural supports (three spans) and design fastening to structural supports to sustain factored loads in accordance with CAN/CSA S136-07.

.3 Calculate live load deflections in accordance with CSSBI 20M-08, as modified by the requirements of this Section.

.4 Provide for movement of components without causing buckling, failure of joint seals, undue stress on fasteners when subject to seasonal temperature range from -40 deg C to +50 deg C, and wind loads noted above.

.5 Design the systems so that there is no air or water infiltration under the positive and negative forces imposed by wind and gravity loads. Provide means of draining space between insulation and exterior skin, in accord with NRC Rain Screen Principles.

.6 Final review and acceptance of work completed by this Section shall be carried out by the manufacturer's representative, the Contract Administrator, Contractor and the Subcontractor.

1.8 STORAGE, DELIVERY, HANDLING AND PROTECTION

.1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off-the-ground, under cover storage locations. Do not load any area beyond the design limits.

.2 Adequately protect and crate all components against damage, dirt, disfigurement and weather.

.3 Assembled units and/or their component parts shall be transported, handled and stored in a manner to preclude damage. Accessory materials required for erection at the Site shall be delivered to the Site in manufacturer's labelled containers. Remove all units or components which are cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace with new.

.4 Provide safe and adequate equipment on the Site to execute the work of this Section, hoisting, scaffolding, staging, safety protection equipment, tools, plant and other equipment required for the completion of the work of this Section.

.5 Delivered damaged materials or materials which do not comply with this Section shall be rejected by Contract Administrator, removed from the Site and replaced with acceptable materials at Contractor's expense.

.6 Adequately protect the structure and work of all other trades during delivery, storage, handling and erection of the work of this Section.

.7 Preformed metal cladding components being hoisted to the working level shall be adequately banded and carefully slung employing steel wire rope.

.8 Bundles shall be tag lined during the ascent of the hoisting operation. Precaution shall be taken to avoid damage to metal cladding components and to prevent marring of exposed surfaces.

.9 Preformed metal cladding components, after being positioned, shall be adequately secured in place as quickly as possible and prior to leaving the job site at the end of the working day.

.10 Loose bundles of preformed metal cladding components shall be adequately secured at the completion of each working day.

.11 Scaffolds, platforms, ladders, and the like, required by the erector for installation of metal cladding components shall be properly secured to prevent accidental movement or collapse.

1.9 PROJECT CONDITIONS

.1 Make thorough examination of drawings and details. Determine the intent, extent, materials, and conditions of interfacing with work of other Sections and be fully cognizant of requirements.

.2 Inspect substrate surfaces on which the work of this Section is erected for any irregularities detrimental to the application and performance of the work of this Section. Confirm conditions satisfactory before proceeding.

.3 Co-ordinate and verify, by measurement at the job site, all dimensions affecting work of this Section. Notify Contract Administrator, in writing, of all dimensions and/or conditions at variance with those on the reviewed shop drawings, Contract Documents and/or detrimental to the proper and timely installation of materials. Direction regarding correction measures shall be obtained from Contract Administrator prior to fabrication of the item affected. Insure the compatibility of adjacent items in relationship to the work of this Section.

.4 Do not perform work of this Section during period of rain, fog, sleet or snow, or upon surfaces covered with dust, water, dew, ice, frost or snow.

.5 Report to Contract Administrator in writing, defects of work prepared by other trades and unsatisfactory Site conditions. Commencement of application implies acceptance of surfaces and conditions.

1.10 COORDINATION

.1 Coordinate work of this section with the requirements of Section 07 62 00 – Prefinished Metal Flashing and Trim, for specific requirements for supply of prefinished sheet metal flashing materials to other sections of the work as follows:

.1 Supply prefinished sheet metal flashings required for the project, regardless of sheet metal thickness and colour.

.2 Provide prefinished sheet metal flashings to installing trades, tension levelled and guillotine sheared to length ready for brake forming, fabrication and installation by installing trades.

.3 Coordinate with installing trades during bid period and provide unit prices for materials based on specified thickness and colour of flashing materials required under their respective scopes of work; installing trades will be responsible for carrying cost for flashing materials in their scope of work in their Bid Price.

.4 Requirements of this portion of the scope of work do not apply to extruded aluminum or other premanufactured flashing materials normally supplied by installing trades (i.e.: extruded aluminum curtain wall flashing and sills, preformed roof penetrations, nonprefinished sheet metal products).

.5 Subcontractor responsible for supply of metal wall cladding will only be responsible for fabrication and installation of flashings relating to their scope of work.

1.11 WARRANTY

.1 Warrant the work of this Section against defects in materials and workmanship in accordance with General Conditions, but for a period of five (5) years. Agree to promptly make good defects which become evident during warranty period without cost to the City.

.2 Without restricting the generality of the Warranty, defects shall include deformation, buckling, leakage, weather tightness, failure of anchors and fastenings, failure of paint coating and sealants.

.3 Promptly make good defects and/or failures in the Work upon written notification by the City. Remedy shall include labour, materials, equipment and services required to make good defective work, and to replace components and finishes and the City's property damaged or disturbed in the course of remedying defects.

2 Products

2.1 MANUFACTURERS

.1 Specified Products: Work of this Section is based on specified products. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

2.2 MATERIALS

.1 Wall Cladding: Sheet steel coil coated to ASTM A755, galvanized by the hot dip process to ASTM A653M, Z275. Factory finish sheet in siliconized polyester coating consisting of epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.005 mm (0.2 mil) for primer and 0.02 mm (0.8 mil) for topcoat.

.1 Cladding MC1: Vertical pattern, colour Cambridge White. AD300R by Vicwest

.2 Cladding MC2: Horizontal pattern, colour White White. AD300 by Vicwest

.3 Cladding MC3: Horizontal pattern, colour White White. AD200 by Vicwest

.2 Flashings, Trims and Closures: Factory finish aluminium of suitable core thickness and finish to match cladding. Inside corners, outside corners, cap strip, drip cap, undersill trim, starter strip and window/door trim of same material and colour as cladding, with fastener holes prepunched.

.1 Colour: Deep Gray by Vicwest

.3 Girts, Clips and Brackets: Thermally brokened, two piece angle girts, stainless steel of required thickness to meet design requirement.

.4 Fasteners: Non-corrosive concealed fasteners of stainless steel, aluminum or cadmium plated steel, as recommended by the manufacturer. Where exposed fasteners are required, provide fasteners in colours matching cladding work.

.5 Sheathing: Refer to Section 09 21 00 Gypsum and Cement Board Assemblies for requirement.

.6 Insulation: Refer to Section 07 21 00 Thermal Insulation for requirement.

.7 Sealing Tape: Macro-polyisobutylene preformed sealant tape designed for use in metal cladding assemblies.

.8 Sealants And Gaskets:

.1 Sealants and gaskets shall be of types to allow for maximum movements anticipated, maintaining life cycle expectancy, adhesion and flexibility under temperature ranges of -25 degree C up to +80 degree C, without undue softening or deleterious effects.

.2 At sidelaps and end laps of panels, as required, factory applied butyl tape, or polyvinyl chloride "wedge fit" type extrusions.

.3 Perimeter Sealant: Multi-component, chemical curing epoxidized polyurethane type sealant conforming to ASTM C920, DYMERIC 240FC' by Tremco (Canada) Ltd., or Sonolastic NP2 by BASF Construction Chemicals..

.9 Isolation Coating: Acid and alkali resistant bituminous paint.

2.3 FABRICATION

.1 Co-ordinate and verify, by measurement at the job site, all dimensions affecting the Work. Submit written notifications documenting any and all field dimensions and/or conditions which are at variance with those on the reviewed shop drawings. The Contract documents and/or detrimental to the proper and timely installation of job site materials. The decision regarding corrective measures shall be obtained from the Contract Administrator prior to the fabrication of the item affected. Ensure the suitability of adjacent items in relationship to the work of this Section.

.2 Report to Contract Administrator in writing, defects in Work prepared by other trades and unsatisfactory Site conditions. Commencement of work shall imply acceptance of conditions.

.3 Workmanship shall be best trade shop and field practice known to recognized manufacturers specializing in work of this Section. Joints and intersecting members shall be accurately fitted to true planes, adequately and securely fastened and made completely weathertight. Component fastenings shall be concealed of adequate strength.

.4 Fabricate units to profile and sizes indicated complete with rabbets, interlocks, flashings, trim and filler sections, as required to interface with work of other trades.

.5 Fabricate all devices required for erection and adequate anchorage and attachment required to be built into or attached to the steel structural or steel deck and main building structure for the support of the Work.

.6 Anchorage brackets and devices shall be designed and fabricated to compensate for unevenness and dimensional difference in the structure and permit unrestricted expansion and contraction of framing members.

.7 Aluminum Welding Materials: Conforms to CSA W59.2.

.8 Fabricate preformed metal cladding systems where indicated. The systems shall be formed to meet design requirements, and of prefinished steel sheet. The system shall be accurately cut and fitted, all fastenings shall be concealed. Method of attachment shall be to the

Contract Administrator's approval and clearly detailed on shop drawings. Panel faces shall be flat and true without waves, buckles or oil canning.

.9 Supply sufficient prefinished metal of same thickness and colours as the preformed metal cladding to Section 07 62 00 – Prefinished Metal Flashing and Trim for his use in installing roof flashings.

.10 Form starter strips of same material as flashings 38 mm (1-1/2") wide and continuous.

.11 Exposed steel surfaces shall be smooth and free from imperfections such as warping, buckling, scratches, dents and abrasion.

.12 Thickness of metal shall be adequate for various conditions.

.13 Isolate where necessary to prevent electrolysis due to dissimilar metal to metal contact or metal to masonry or concrete. Use bituminous paint or other approved divorcing membrane.

3 Execution

3.1 INSTALLATION

.1 Erect preformed metal cladding and accessories in strict accordance with reviewed shop and erection drawings and manufacturer's instructions to give a complete and weatherproof system.

.2 Install underlayment and protective membrane under preformed metal cladding and elsewhere as required in strict accordance with manufacturer's written instructions forming a complete waterproof barrier, free of leaks.

.3 Install girts, 'Z' girts, liner panels, sub-girts, cleats and retention clips and other attachment members necessary to complete the work of this Section.

.4 Co-operate with other trades to ensure proper installation and anchorage of work of this Section. Install steel bracing and framing and continuous clip angles and secure plumb and in line.

.5 Damaged, bent or dished sheets will be rejected.

.6 Place preformed metal cladding against supporting substrate and adjust to final position before permanently securing. Bring each unit to bear evenly on framing.

.7 Align units to provide accurate fit with corresponding sections parallel and straight. Ensure complete nesting of interlocking and sealed side lap joint and fasten sheets to structural supports.

.8 Fasten exterior sheets of panels to horizontal sub-girts, using colour matching fasteners, where indicated.

.9 Install necessary closure and trim or neoprene closures at openings and penetrations, fastening at 305 mm (12") O.C. Make cut-outs neatly by saw cutting.

1. Install cladding as indicated.

.10 Where welding has been performed on work of this Section, or field cutting or scratches have been made, field coat such areas with touch-up paint after thoroughly cleaning affected surfaces.

.11 Seals:

.1 Fit flexible seals, tapes, formed gaskets and the like at locations required to provide air/vapour barriers and weathertight junctions. Ensure that end joints, between lengths of material have been properly sealed.

.2 Caulk junctions of preformed metal cladding system components to themselves and work of other Sections with sealant in accordance with the requirements of Section 07 92 00 – Sealants, to maintain continuity of air/vapour and weather barriers.

.12 Rigidly connect all prefinished flashing pieces with specified colour matching fasteners at 305 mm (12") O.C. along length. Use preformed corner pieces and erect with ample allowance for thermal movement.

.13 Furnish adequate quantity of prefinished flat stock flashing sheet to Section 07 62 00 – Prefinished Metal Flashing and Trim for forming and installation. Trim members in this category are cap flashing, base flashing and those specifically shown on drawings as being prefinished and in close proximity to roofing. Flashing pieces entirely remote from roofing flashing and the like are furnished in place under work of this Section.

.14 Install work of this Section only during period of no rain, fog, sleet or snow, or upon surfaces covered with dust, water, dew, ice, frost or snow.

3.2 CLEANING AND CLEAN-UP

.1 Remove debris and surplus materials from the Site upon completion of work of this Section.

.2 Clean dirt, soil and misplaced sealants from preformed metal cladding systems with recommended cleaners and solvents.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Work of this section include the supply and installation of a conventional SBS Modified Bituminous Membrane Roofing system, accessories, and site quality control as indicated in this section.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 Canadian Roofing Contractors' Association (CRCA):

.1 Roofing Specification Manual

.3 Provincial Roofing Contractors Association Roofing Specification Manual

.4 American Society for Testing and Materials (ASTM):

.1 ASTM D4263-83 (2012), Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

.2 ASTM E84 –15, Standard Test Method for Surface Burning Characteristics of Building Materials

.5 Canadian General Standards Board (CGSB):

.1 CGSB 37GP56M, Membrane, Modified, Bituminous, Prefabricated and Reinforced for Roofing

.2 CGSB 37GP64M, Mat Reinforcing, Fibrous Glass, for Membrane Waterproofing Systems and Builtup Roofing

.3 CAN/CGSB-37.5-M89, Cutback Asphalt Plastic Cement

.4 CAN/CGSB-37.28-M89, Reinforced, Mineral Colloid Type, Emulsified Asphalt for Roof Coatings and Waterproofing

.5 CGSB 37GP9Ma, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing or Waterproofing

.6 Canadian Standards Association (CSA):

.1 CSA A123.404(R2013), Asphalt for Constructing Builtup Roof Coverings and Waterproofing Systems

.2 CSA B111-1974 (R2003), Wires, Nails, Spikes and Staples

.7 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC S107-10, Methods of Fire Tests of Roof Coverings

.2 CAN/ULC S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering

.3 CAN/ULC S702-14, Standard for Mineral Fibre Thermal Insulation for Buildings

.4 CAN/ULC S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit copies of membrane manufacturers current technical data sheets describing the physical properties and recommended installation procedures.

.2 Shop Drawings:

.1 Submit sloped insulation manufacturer's proposed roofing diagrams and layouts for review by the Contract Administrator.

.2 Submit membrane manufacturer's standard details that will be used for this project, indicate changes that must be made to make the details project specific for review by the Contract Administrator.

.3 Informational Submittals: Certificates: Provide roofing system materials that are compatible with building air and vapour retarders specified under Section 07 27 13 – Self-Adhered Air and Vapour Barrier Sheet Membrane.

1.5 SYSTEM PERFORMANCE

.1 General Performance: Installed membrane roofing shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

.2 Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

.3 Minimum Adhesion of Each Material: 1 MPa.

.4 Fire Hazard and Windstorm Requirements:

.1 Provide membrane roofing, base flashings, and component materials equivalent to requirements in as part of a membrane roofing system and as follows:

.1 Fire Hazard Classification: CAN/ULC-S107, Class C.

.2 Roof Assembly wind uplift requirements: tested in accordance with CSA A123.21, Standard test method for the dynamic wind uplift resistance of membrane-roofing systems.

.5 Expected Service Life: CSA S 478; Provide a fully adhered roofing system whose cap sheet and cap sheet flashings have a predicted service life of a minimum of 20 years in accordance with requirements of Part 7 of CSA S 478.

.6 Thermal Resistance of Insulation: Minimum effective thermal resistance as indicated in accordance with CAN/ULC-S770-3 - LTTR testing and the following:

.1 Do not include other system componentry such as air surface films, structural materials, membranes, tapered insulation, roof sheathing component contributions in the calculation.

.7 Roof slope: Minimum 2% slope to drain.

1.6 QUALITY ASSURANCE

.1 Obtain roofing membrane materials through one source from a single manufacturer and install using workers who are trained and approved by the roofing membrane manufacturer; maintain a full time experienced journeyman roofer, and at least one apprentice per crew on the Work at all times.

.2 Roofing and sheet metal work will be performed in conformance with the roofing manufacturer's written recommendations using materials that meet the requirements of CAN/ULC S107 to obtain a Class A fire resistance rating; submit proof that roofing materials meet required performance when requested by the Contract Administrator.

.3 Conform to Roofing Specifications as published by Canadian Roofing Contractors Association (CRCA) and local provincial roofing contractors association of the project as a reference.

.4 Perform the work of this Section by a company which has a minimum of five (5) years of proven satisfactory experience in the Work of this Section.

.5 Execute work of this section using an applicator approved by the roofing membrane manufacturer.

1.7 FIRE PROTECTION

.1 Protect roof junctions at parapets, roof curbs and upstands with a fire-resistant tape or barrier to prevent combustible materials within assemblies from ignition arising from the use of torches. Install prior to installation of base sheets.

.2 Use a heat detector gun to spot any smouldering or concealed fire at the end of each work day. Establish a minimum one (1) hour fire watch after torch application.

.3 Do not apply torch directly to dry or unprotected wood surfaces.

.4 Maintain a clean site and have one approved ABC fire extinguisher within 6 meters of each roofing torch. Respect all safety measures described in manufacturer’s technical data sheets. Do not place torches near combustible or flammable products.

1.8 STORAGE, DELIVERY, HANDLING AND PROTECTION

.1 Deliver materials to the job site; handle and store in original packages and containers with manufacturer's seals and labels intact. The manufacturer's name, brand, mass, specification number and lot number must be shown on the labels.

.2 Store materials in weatherproof shelters having floors that will protect the materials from moisture. Store materials on end. Avoid prolonged exposure of light or heat sensitive materials to sunlight.

.3 Do not store materials on roof in concentrations that exceed design live load.

.4 Place plywood runways over the Work to enable the movement of materials and other traffic during construction of roofing.

.5 Protect surrounding surfaces against damage from roofing work. Where hoisting is necessary, hang tarpaulins to protect walls during delivery of materials from ground to roof.

.6 In the event of materials damage by the elements, improper handling or other causes, such materials will be rejected and will be replaced at no extra cost to the City. Remove rejected materials promptly from the site.

.7 During roofing work, exposed surfaces of finished walls must be protected with tarp to prevent damage. Contractor shall assume full responsibility for damage.

1.9 PREINSTALLATION MEETING

.1 Arrange a pre-construction meeting in accordance with Section 01 31 19 – Project Meetings.

.2 Include the roofing manufacturer's representative, roofing contractor's representative, the roofing inspector, the Contractor, the Contract Administrator and the City.

.3 The purpose of this meeting is to review installation conditions particular to this project and review materials specified in this section.

.4 The roofing inspector will complete the minutes and prepare a report for this meeting.

1.10 SITE CONDITIONS

.1 Minimum ambient application temperature shall not be less than 20 deg C. Notify Contract Administrator and roofing inspector where installation is required below stated minimum temperature and submit manufacturer's standard cold weather installation practices prior to proceeding with work of this section.

1.11 WARRANTY

.1 Manufacturer's Warranty: Transferable, Total System/Labour, Material & Workmanship Warranty, No Dollar Limit, Non-Pro-Rated for a period of twenty (20) years from date of Substantial Performance for the project including; but not limited to, the following components:

.1 Roofing membrane

.2 Base flashings

.3 Roofing membrane accessories

.4 Roof insulation

.5 Other components of membrane roofing system

.2 Submit for the City's acceptance, manufacturer's warranty document indicated above, executed by an authorized company official.

2 Products

2.1 MATERIALS - GENERAL

.1 Source Limitations: Obtain roofing materials and components with products within the same roof assemblies of the same on manufacturer, or approved materials by the roofing membrane manufacturer to be covered by the warranty.

.2 Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

2.2 MANUFACTURERS - MEMBRANE MATERIALS

.1 Specified Products: Work of this Section is based on products manufactured by Soprema Canada. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance:

.1 Firestone Building Products Canada.

.2 IKO Industries Ltd.

.3 Tremco Commercial Sealants & Waterproofing.

.4 Siplast.

2.3 MEMBRANE MATERIALS

.1 Roof Membrane: CAN/CGSB-37-GP-56M, asphalt and polymer modifiers of styrene-butadiene-styrene (SBS) prefabricated sheet.

.1 Prefabricated Roof Base Sheet: CGSB 37-GP-56M Type 2, Class C, Grade 1, with heavy duty composite glass and polyester reinforcement:

.1 Thickness: 2.2 mm.

.2 Application: Fully adhered.

.3 Top Surface: Thermofusible plastic film.

.4 Underside Surface: Sanded face.

.5 Product: Elastophene 180 PS by Soprema Canada.

.2 Prefabricated Base Sheet Flashing: CGSB 37-GP-56M Type 2, Class C, Grade 2, reinforced with woven fibre glass 180 g/m2:

.1 Thickness: 3.0 mm.

.2 Application: Fully adhered.

.3 Top Surface: Thermofusible plastic film.

.4 Underside Surface: Self-adhesive, covered with a silicone release film.

.5 Product: Sopraflash Flam Stick by Soprema Canada.

.3 Cap Sheet Membrane and Flashing: CGSB 37-GP-56M Type 1, Class A, Grade 2, asphalt and polymer modifiers of styrene-butadiene-styrene (SBS) type, heavy duty composite glass and polyester reinforcement; upper surface finished with a factory applied white finish providing an SRI +/- 85 with the following characteristics:

.1 Thickness: 3.5 mm.

.2 Application: Fully adhered.

.3 Top Surface: Highly reflective white granules.

.4 Underside Surface: Thermofusible plastic film.

.5 Product: Soprastar FLAM HD GR by Soprema Canada.

2.4 BITUMEN MATERIALS

.1 Asphalt Primer: Elastocol Stick by Soprema for self-adhered applications; Elastocol 500 by Soprema for heat welded applications.

.2 SEBS Asphalt: ASTM D6152; A blend of SEBS and select asphalt for adhering membranes and overlay board.

.3 Asphalt Bitumen: CSA A123.4M Roof Asphalt Type 3.

.4 Plastic Cement: ASTM D2822 Type I or II, cutback asphalt type as recommended by roofing system manufacturer for application.

2.5 VAPOUR RETARDER

.1 Prefabricated Vapour Retarder Membrane (noted as membrane in roof system): Self-adhesive air/vapour barrier membranes composed of bitumen modified with thermoplastic polymers and high-density polyethylene film with the following characteristics:

.1 Water Vapour Permeance: +/- 1.7 ng/Pa.s.m2 (0.03 perm)

.2 Thickness: 0.8 mm.

.3 Product: Sopravap'R by Soprema Canada.

.2 Prefabricated Vapour Retarder Transition Strip and Flashing Self Adhesive: Asphalt and polymer modifiers of styrene-butadiene-styrene (SBS) type, polyester and glass reinforcement; smooth surfaced, as approved by system's manufacturer.

2.6 INSULATION

.1 Provide roof insulation with minimum total of R-value as indicated in the drawing.

.2 Total aggregate thermal resistance of roof system to be minimum effective as indicated.

.3 Base Roof Insulation; Faced Polyisocyanurate insulation boards, CAN/ULC-S704, Type 3, Class 3, HCFC and CFC-free, rigid board, inorganic coated-glass facers, and square edges.

.1 Board Density: 32 kg/cu m.

.2 Thermal Resistance: Min LTTR value of RSI value of 1.8 per 50 mm.

.3 Board Size: 1220 x 1220 mm and 1220 x 2440 mm

.4 Thickness: To requirement as indicated in the drawing.

.5 Basis of Products:

.1 SOPRA-ISO PLUS by Soprema Canada.

.6 Other Acceptable Products:

.1 AC Foam III by Atlas Roofing Corporation.

.2 RESISTA ISO by Holcim Elevate.

.3 IKOTherm III by IKO Industries Ltd.

.7 Tapered Insulation:

.1 Board Thickness: As required for fabrication of slopes with a minimum thickness of 13 mm.

.2 Fabricate to minimum slope to drain meeting performance criteria specified. Provide custom saddles, sumps, crickets, tapered edge strips and other insulation shapes with increased local slopes to prevent trapping of water behind parapets returns or curbs.

.3 Design a custom configured sloping insulation to provide minimum slope to drains with custom sloped accessories.

.4 Single layer insulating system combining base insulation and tapered insulation will not be accepted as substitute to multi layer insulating system.

2.7 GYPSUM ROOF SHEATHING AND OVERLAY BOARD

.1 Gypsum roof sheathing: ASTM C1396; 13 mm thick unless otherwise indicated; primed finish with non-woven glass mats embedded in a water resistant treated gypsum core; minimum compression strength 500 psi.

.1 Product:

.1 DensDeck Prime Roof Board by Georgia-Pacific Gypsum LLC.

.2 Securock Gypsum Fiber Roof Board by CGC Inc.

.2 Insulation Overlayment: 6 mm (1/4") thick board, mineral filled asphalt core between glass fiber facers, acceptable to roofing membrane manufacturer.

2.8 ADHESIVES

.1 Insulation Adhesive: One or two component, low-rise, chemically cured urethane foam adhesive for the attachment of selected rigid roof insulation to one another and to adhere to

vapour barrier membranes; contains no solvents and is compatible with the roofing Manufacturers system.

.1 Basis of Products:

.1 Duotack by Soprema Canada.

2.9 ACCESSORIES

.1 Sheathing Joint Tape: Paper, heat-resistant type.

.2 Insulation Joint Tape: Asphalt treated glass fibre reinforced; 150 mm wide; self adhering.

.3 Flame-Stop Tape: Self-adhesive membrane composed of SBS modified bitumen and a glass mat reinforcement, designed to prevent flames from penetrating into voids, cavities and openings before installing heat-welded membranes; type recommended by membrane Manufacturer.

.4 Roofing Nails: Galvanized, hot dipped type, size as required to suit application.

.5 Jointing Material for Overlay Board: Tape or sealant as recommended by membrane manufacturer.

.6 Sealants: As recommended by membrane manufacturer.

.7 Cant Strips: Fabricated from High density mineral wool, asphalt impregnated facer for torch application; 100 mm x 100 mm fabricated to 45 degree angle (with min.140 mm sloped face) dimension.

.1 Cant Strip-Insulation Adhesive: Recommended by membrane manufacturer.

.8 Termination Bars: Aluminum, surface mounted, prepunched, maximum possible length per location, with attachment flanges.

.9 Walkway: SBS modified membrane reinforced and nonwoven polyester fabric granular surfaced, suitable for torch-on application, free of selvedge.

.1 Size: Minimum 5.0 mm thick.

.2 Granule Colour: Different from cap sheet and as selected by Contract Administrator.

.3 Product: Soprawalk by Soprema Canada.

.10 Miscellaneous Accessories: Provide all miscellaneous accessories recommended by roofing system manufacturer.

.11 Roof drain: Refer to Mechanical Drawings.

3 Execution

3.1 GENERAL

.1 Perform roofing installation in accordance with membrane manufacturer’s written instructions and to CRCA and local provincial roofing contractors association of the project Roofing Specifications Manual requirements.

.2 Coordinate installation of roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

.1 At end of each day's work, provide water cut-offs to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed. Minimize or eliminate staggered joints to accommodate water cut-offs.

.2 Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system. Use membrane flashings consistent with permanent detailing sealed to base layer and vapour retarder with minimum 100 mm laps.

.3 Remove and discard temporary seals before beginning work on adjoining roofing.

.3 Provide water cut-offs to prevent dispersion of moisture at insulation level throughout roof assembly, in the event of future roof leak. Locate cut-offs at 9 m intervals each way.

.4 Install cap sheets within 48 hrs of installation of base sheets.

.5 No visible fasteners permitted on underside of exposed decks.

3.2 EXAMINATION

.1 Verify that surfaces and site conditions are ready to receive work.

.2 Verify deck is supported and secured.

.3 Verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains.

.4 Verify deck surfaces are dry and free of snow or ice.

.5 Confirm dry deck by moisture meter with 12 percent moisture maximum.

.6 Verify roof openings, curbs, pipes, conduit, sleeves, ducts, and vents through roof are solidly set, and correctly located.

3.3 PREPARATION – GENERAL

.1 Prepare surfaces in accordance with Standards and manufacturer’s written installation instructions of CRCA and local provincial roofing contractors association of the project.

3.4 GYPSUM ROOF SHEATHING

.1 Apply with adhesive in conformance with manufacturer's written recommendations to obtain wind uplift rating specified.

3.5 VAPOUR RETARDER APPLICATION

.1 Primer: Apply primer in accordance with manufacturer's written instructions for system specified. Allow to dry.

.2 Apply vapour retarder to substrate surface with adhesive overlapping side and end laps in conformance with manufacturer's written recommendations.

.3 Stagger laps a minimum of 300 mm.

.4 Begin work at bottom of slopes; unroll and align on substrate, ensuring full contact and support at edges.

.5 Meet and overlap air/vapour barrier on adjoining walls.

.6 Seal membrane at insulation perimeters and around penetrations to ensure sealed connections with base sheet at upstands.

3.6 INSULATION APPLICATION

.1 Install insulation to manufacturer written instructions.

.2 Ensure vapour retarder is clean and dry.

.3 Bottom Insulation: Install bottom layer of insulation in minimum 2 layers. Apply adhesive to substrate in accordance with adhesive and insulation manufacturer's written instructions.

Embed first layer of insulation into adhesive over vapour retarder in accordance with manufacturer's recommendations.

.1 For second layer of bottom insulation, apply adhesive to the top surface of first layer of insulation. Embed the second layer of insulation into adhesive, with joints staggered minimum 300 mm from joints of first layer.

.4 Tapered Insulation: Place constant thickness first layer and tapered thickness insulation second layer to indicated slope pattern in accordance with manufacturer's written instructions.

.1 Embed insulation into adhesive as per manufacturer's instructions.

.5 Minimum Total Insulation Thickness: As required to achieve insulation R or RSI value as indicated. Do not use tapered insulation in the calculation of thickness required.

.6 Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

.7 Lay tapered boards for a distance of 450 mm back from roof drains for positive drainage.

.8 Apply no more insulation than can be covered with membrane in same day.

3.7 OVERLAY BOARDS

.1 Install overlay boards with adhesive in accordance with manufacture recommendations over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints a minimum of 150 mm in each direction from joints of insulation below. Loosely butt cover boards together. Tape or seal joints if required by roofing system manufacturer.

.2 Immediately cover overlay boards with subsequent materials; do not leave exposed.

3.8 MEMBRANE APPLICATION

.1 Apply membrane and primer to manufacturer written instructions.

.2 Hot mop –fully adhere base sheet with SBS modified asphalt at a rate of 1.25 kg/m2.

.3 Apply membrane; lap and seal edges and ends permanently waterproof.

.4 Apply membrane smooth, free from air pockets, wrinkles, or tears. Ensure full bond of membrane to substrate. Use rollers

.5 Extend membrane minimum of 200 mm onto vertical surfaces. Secure base sheets to vertical surfaces of parapets with binder bars.

.6 Extend membrane over vapour and air barrier of wall construction and seal.

.7 Mop and seal membrane around roof protrusions and penetrations.

.8 Torch cap sheet to manufacturer written instructions. On exposed membranes lap cap sheets at seams to limit bitumen bleed-out. Alternatively, apply loose granules of same colour as cap sheet to bitumen bleed-out while material is hot; ensure full coverage and embedment. Visible bleed-out not permitted.

3.9 FLASHINGS AND ACCESSORIES

.1 Apply flexible sheet base flashings to seal membrane to vertical elements.

.2 Secure to nailing strips at 100 mm on centre.

.3 Fabricate roofing control and expansion joints to isolate roof into areas as indicated.

.4 Install prefabricated roof penetration flashings and expansion joint flashings in accordance with manufacturer's instructions.

.5 Coordinate installation of roof drains, curbs, and related flashings.

.6 Seal flashings and flanges of items penetrating or protruding through the membrane.

.7 At locations where standard flashing materials cannot be used apply liquid membrane flashing in accordance with manufacturer's details.

3.10 SITE QUALITY CONTROL

.1 The City will hire an independent inspection agency for this project to provide inspection services and verify conformance of roofing to specified requirements. The City to appoint and pay for roof inspections.

.2 Notify Inspection Company, roofing membrane manufacturer and Contract Administrator 72 hours in advance of commencing roofing. Inspection Company will:

.1 Carry out full and complete inspections while the work is in progress, at completion of roofing installation and just prior to the date of Substantial Performance

.2 Inspect and review materials and workmanship including storage, handling and protection. Advise the Contract Administrator and the City of inspections.

.3 Include procedures followed; ambient temperatures, humidity, wind velocity during application.

.4 Submit a daily report while work is in progress to the City, Contract Administrator, Roofing subcontractor and Contractor. This report is to be countersigned by the Roofing Subcontractor's Superintendent acknowledging content.

.3 Inspection of all roofing to be provided by the City appointed inspection agency.

3.11 MANUFACTURERS SITE SERVICES

.1 Attend Pre-installation Meetings:

.1 Review preparation and installation procedures and coordinating and scheduling required with related work.

.2 Require site attendance of roofing system manufacturer's technical personnel during installation of the Work to provide field surveillance of the installation of their Products:

.1 Schedule of Site Visits: Provide a minimum of three visits beginning with initial start-up of installation, at 25% completion and at 50% completion for each roof assembly.

.2 Inspect and review materials and workmanship including storage, handling and protection. Advise Contract Administrator and the City 48 hours in advance of inspections.

.3 Monitor and report installation procedures and unacceptable conditions.

.4 Manufacturer's representative to provide a written Site Report for each Site visit.

.3 Correct identified defects or irregularities.

.4 Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion of roofing membrane and flashing.

.1 Notify Contract Administrator and the City 48 hours in advance of date and time of final inspection.

.2 Manufacturer's representative to provide a written Site Report for Final Inspection.

3.12 CLEANING

.1 In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

.2 Repair or replace defaced or disfigured finishes caused by work of this section.

3.13 PROTECTION OF FINISHED WORK

.1 Protect building surfaces against damage from roofing work.

.2 Where traffic must continue over finished roof membrane, protect surfaces using 19 mm thick plywood sheets of plywood arranged and installed to prevent tripping and wind uplift.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Furnish labour, materials and other services to complete the fabrication and installation of;

.1 Cap and base flashing; curb flashings,

.2 Roof edge flashing,

.3 Flashing at intersection of roof with vertical surfaces,

.4 Break metal flashings where shown,

.5 Prefinished flashings where indicated,

.6 Any other flashing as indicated on the drawings or as required, including all materials and fitments required for the operation of any unit furnished, in the manner, direction and performance shown on the shop drawings and specified herein.

.2 Furnish, complete, all materials which shall be installed by other trades as specified and/or shown on the drawings including:

.1 Furnish to Section 04 22 00 all metal flashings and counter flashings which are to be built into masonry work.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.

.2 ASTM C920, Standard Specification for Elastomeric Joint Sealants.

.3 Canadian Roofing Contractors Association

.1 CRCA Specifications Manual

1.4 SUBMITTALS

.1 Provide submittals specified and as required to assess conformance with the Contract Documents, in accordance with the Contract Requirements, Contract General Requirements.

.2 Submit shop drawings indicating material, thickness and finish.

.3 Submit duplicate 100mm x 100mm (4” x 4”) samples of each type of sheet metal material, colour and finish for review by Contract Administrator prior to fabrication.

.4 Sustainable Design Submittals:

.1 LEED Submittals: Co-ordinate submittals requirements, submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Recycled Content: provide listing of products incorporating recycled content. Include details of percentages of post-consumer and pre-consumer recycled content for materials and products. Indicate material and product costs.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20% of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project.

1.5 QUALITY ASSURANCE

.1 Fabricator and tradesmen executing the work of this Section shall have had a minimum five (5) years continuous Canadian experience in successful manufacture and installation of Work of type and quality shown and specified. Submit proof of experience upon Contract Administrator's request.

.2 Erection of metal flashing systems shall be by workmen especially trained and experienced in this type of work. Have a senior, qualified representative at the job site to direct the work of this Section at all times.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Store materials flat at site under protection to prevent staining from the work of other trades or from collection of water on material and secured against wind damage.

.2 Carefully store preformed sheet metal work in such a manner as to prevent twisting, bending and rubbing.

.3 Protect sheet metal work from corrosive materials and dissimilar metals.

1.7 WARRANTY

.1 Warrant the work of this Section against defects in materials and workmanship in accordance with General Conditions, but for a period of two (2) years. Agree to promptly make good defects which become evident during warranty period without cost to the City.

.2 Without restricting the generality of the Warranty, defects shall include deformation, buckling, leakage, weather tightness, failure of anchors and fastenings, failure of paint coating and sealants.

.3 Promptly make good defects and/or failures in the work of this Section upon written notification by the City that such exist. Remedy shall include labour, materials, equipment and services required to make good defective work, and to replace components and finishes and the City's property damaged or disturbed in the course of remedying defects.

2 Products

2.1 MATERIALS

.1 Zinc Coated Steel Sheet: ASTM A653/A653M, commercial quality, with Z275 designation zinc coating, factory finished, minimum 0.89 mm (0.0336") base metal thickness.

.2 Nails, bolts screws and rivets: Material - galvanized steel, stainless steel or same metal as material to be fastened. Type - to approved samples.

.3 Isolation coating: Alkali and acid resistant bituminous paint.

.4 Zinc Rich Paint For Touch-up of Galvanized Metals: Ready mixed, zinc-rich primer conforming to CAN/CGSB-1.181, Zinc Clad No. 5 Organic Zinc Rich Primer by Sherwin Williams Company of Canada Ltd., or approved equal.

.5 Underlay for metal flashing: Asphalt laminated 3.6 to 4.5 kg kraft paper.

.6 Sealant: Multi-component, chemical curing epoxidized polyurethane type sealant conforming to ASTM C920 Dymeric 240FC by Tremco (Canada) Ltd., or approved equal. Colour as

selected later by Contract Administrator. Provide primers, bond breakers and cleaning agents as recommended by the sealant manufacturer.

.7 All other materials not specifically described but required for a complete and proper installation of the work of this Section shall be new first quality of their respective kinds and subject to the approval of the Contract Administrator.

2.2 FABRICATION

.1 Fabricate metal flashings and other sheet metal work to applicable CRCA 'FL' series specifications and as detailed.

.2 Form flashings, counter flashings, scuppers and copings as required to suit each condition. Use prefinished sheet steel in all locations. Form pieces in 2438 mm (8'-0") maximum lengths. Make allowance for expansion at joints.

.3 Fabricate sheet metal components with lines, arises and angles sharp and true and plane surfaces free from objectionable wave, warp or buckle.

.4 Mitre and seal corners with sealant. Form drip edging at 45 deg angle, secure with a continuous 20 ga. hold-down clip.

.5 Exposed edges of sheet metal shall be folded back to form a 13 mm (1/2") wide hem on the side concealed from view. Prefabricate corner pieces for flashings and copings. The workmanship and methods employed for forming, anchoring, cleating and the provision for expansion and contraction of sheet metal work shall be to the approval of the Contract Administrator.

.6 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.7 Fabricate scuppers and overflow scuppers to applicable CRCA 'FL' Series details and as detailed.

.8 Apply two coats of bituminous paint to metal surfaces to be in contact with masonry, concrete, mortar or dissimilar metals.

2.3 FINISHING

.1 Factory Finished Metal Sheets.

.1 Silicone Modified Polyester: Coating thickness: not less than 25micrometres, custom colour.

3 Execution

3.1 EXAMINATION

.1 Inspect substrate surfaces on which the work of this Section is erected for any irregularities detrimental to the application and performance of the Work. Confirm conditions satisfactory before proceeding. Report to Contract Administrator in writing, defects of work prepared by other trades and unsatisfactory site conditions. Commencement of work implies acceptance of surfaces and conditions.

3.2 INSTALLATION

.1 Metal flashing shall be in compliance with best sheet metal trade practice and shall in no way be contrary to sheet metal practice that will qualify for the Guarantee Certificate specified. Install with "S" lock expansion joints or standing seams incorporated on end of flashing length and all joints sealed with mastic.

.2 Provide continuous starter strips to present true, non-waving leading edge. Provide clips and anchor to backup in an approved manner to provide rigid, secure installation. Conceal fastenings in completed flashing. Lap, lock and seal all seams.

.3 Provide underlay under sheet metal. Secure in place and lap joints 100mm (4").

.4 Install sheet metal flashings, cap flashings and copings as indicated on drawings using flat lock seams. Make joints to permit thermal movement. Make surfaces free from buckling, warp, wave, dents, oil canning or other defects. Make corners square and surfaces straight and in true planes. Equally space joints in cap flashings to suit wall panel module. Space seams not farther apart than 2439mm (8').

.5 All sheet and strip flashing to be held in place by 14 gauge galvanized iron clips of a size and type to be determined by the construction requirements, except where specifically detailed on the drawings.

.6 Caulk flashing at cap flashing with sealant.

.7 Lock end joints and caulk with sealant.

.8 Use rubber-asphalt sealing compound for joints between sheet metal and bitumen.

.9 Supply rigid flashing, copings and sheet metal back-up to other trades where required to be built into other work at doors, windows, block openings, curbs and where shown on drawings.

.10 Take careful note of fans, vents, etc., on mechanical drawings to determine whether flashing and counter flashing is required or whether units are self-counter flashing.

.11 Caulking shall be installed as per written manufacturer's recommendations.

.12 Exposed fastenings will be permitted where indicated or where concealed fastening is not possible. Obtain Contract Administrator’s approval of exposed fastenings and methods of making same.

.13 If exposed screws or bolts are used, use cupped neoprene washers.

.14 Install scupper drains and overflow scupper drains as indicated on drawings, in strict accordance with CRCA manual.

3.3 CLEANING

.1 Remove, as the work progresses, all excess or foreign material which would set up or become difficult to remove from finished surfaces.

.2 Do all final cleaning upon completion of the Work of this Section. Leave building and Work in condition to meet the approval of the Contract Administrator.

.3 Remove excess sealant by the moderate use of mineral spirits or other solvent acceptable by the sealant manufacturer.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Furnish labour, materials and other services to complete the fabrication and installation of:

.1 Preformed Penetration Flashings.

.2 Roof Supports.

.2 Accessories and flashing material as required and as indicated on the drawings, including all materials and fitments required for the operation of any unit furnished, in the manner, direction and performance shown on the shop drawings and specified herein.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Bearing professional seal and signature of a professional engineer responsible for the engineering design of work of this Section. Show accessory profile, layout, materials, construction, and securement method to building structure.

.2 Furnish complete shop and erection drawings required for the work of this section to the Contract Administrator for review prior to fabrication. Shop drawings shall bear the seal and signature of a Professional Engineer registered to practice at the Place of Work.

.3 Co-ordinate shop drawings for work of this section with those for other trades to ensure correct interface details required to provide watertight installation.

.4 Shop drawings shall incorporate plans, elevations, sections and details for all work in this Section. The details shall show and specify all metal thicknesses, types and finishes; areas to be sealed and sealant materials; type of construction including joinery, fasteners and welds; all anchorage assemblies and components; connections, fastenings, shapes and finishes; the fabrication and erection tolerances for the work in this section and the adjoining related work of other sections.

.2 Product Data: Submit product data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

.3 Maintenance Manuals: Include complete written and illustrated instruction manuals relative to the care, adjustment and operation of all parts of the equipment, a complete description and listing of components, with recommended frequency of service and maintenance to ensure maximum efficiency, reliability and long life of the equipment.

1.4 QUALITY ASSURANCE

.1 Fabricator and tradesmen executing the work of this Section shall have had a minimum five (5) years continuous Canadian experience in successful manufacture and installation of Work of type and quality shown and specified. Submit proof of experience upon Contract Administrator's request.

.2 Erection of roofing specialties shall be by workmen especially trained and experienced in this type of work. Have a senior, qualified representative at the job site to direct the work of this Section at all times.

.3 Maintenance Seminars: Engage a factory authorized service representative to train the City's maintenance personnel on proper maintenance procedures.

.4 Pre-Installation Meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.5 Manufacturer's Site Inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. Submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.6 Source Limitations: Obtain each type of product from a single manufacturer.

1.5 DELIVERY/STORAGE/HANDLING

.1 Inspect material upon delivery and order replacements for any missing or defective items. Keep material dry, covered and off the ground until installed.

1.6 WARRANTY

.1 Warrant the work of this Section against defects in materials and workmanship in accordance with General Conditions, but for a period of two (2) years. Agree to promptly make good defects which become evident during warranty period without cost to the City.

.2 Without restricting the generality of the Warranty, defects shall include deformation, buckling, leakage, weather tightness, failure of anchors and fastenings, failure of paint coating and sealants.

.3 Promptly make good defects and/or failures in the work of this Section upon written notification by the City that such exist. Remedy shall include labour, materials, equipment and services required to make good defective work, and to replace components and finishes and the City's property damaged or disturbed in the course of remedying defects.

2 Products

2.1 MANUFACTURERS

.1 Specified Products: Work of this Section are based on specified products. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

2.2 PREFORMED PENETRATION FLASHINGS

.1 Split Flashing: 0.46 mm (0.018") thick type 304 stainless steel with matching cap, properly sized, EPDM grommet capped seals, continuous EPDM split junction and deck flange seals, coated deck flange compatible with roofing system.

.1 Round Flashing, Non-Vented Cap: SPJ-1 by Thaler.

.2 Round Flashing, Vented Cap: SPJ-2 by Thaler.

.3 Square Flashing, Non-Vented Cap: SPJ-3 by Thaler.

.4 Square Flashing, Vented Cap: SPJ-4 by Thaler.

.2 Single Flexible Conduit Flashing: Liquid tight, 2.7 mm (0.109") thick mill finished 6061-T4 aluminium, EPDM end and cap seals, properly sized holes to suit conduits, coated deck flange compatible with roofing system, MEF-2A Series by Thaler.

.3 Single Rigid Conduit Flashing: 0.46 mm (0.018") type 304 stainless steel, insulated, EPDM end and cap seals, properly sized holes to suit conduits, coated deck flange compatible with roofing system, MEF-SSE1 Series by Thaler.

.4 Double Flexible Conduit Flashing: 1.6 mm (0.064") thick mill finished 1100 aluminium, insulated, moulded-in-place EPDM grommet seals, properly sized holes to suit conduits, galvanized conduit fittings, aluminium base enclosure, coated deck flange compatible with roofing system, MEF-AE2 by Thaler.

.5 Multiple Flexible Conduit Flashing: Flexible flashing, 1.6 mm (0.064") thick mill finished 1100 aluminium, insulated, moulded-in-place EPDM grommet seals, properly sized holes to suit conduits, galvanized conduit fittings, aluminium base enclosure, coated deck flange compatible with roofing system, MEF-AE4 by Thaler.

.6 Exhaust Vent Flashing: 1.6 mm (0.064") thick mill finished 1100 aluminium, two piece collar, EPDM grommet cap seals, properly sized holes to suit vent, coated deck flange compatible with roofing system, MEF-4A Series by Thaler.

.7 Hot Pipe Flashing: 1.6 mm (0.064") thick mill finished 1100 aluminium, two piece collar, properly sized to suit hot pipe, coated deck flange compatible with roofing system, MEF-3A Series by Thaler.

.8 Stack Vent Flashing: Vandal resistant, 1.6 mm (0.064") thick mill finished 1100 aluminium body, hood and perforated collar, premoulded polyurethane insulation liner, EPDM grommet cap seals, properly sized holes to suit vent, coated deck flange compatible with roofing system, SPJ-31 Series by Thaler.

2.3 ROOF SUPPORTS

.1 Access Ladder Supports: Epoxy coated, hot dipped galvanized hollow steel support complete with appropriate hardware for fastening to structural roof deck; epoxy coated threaded steel cap with ladder lugs suitable for receiving a minimum 13 mm (1/2") thick steel ladder side rails; 10 mm (3/8") stainless steel retaining bolts; and urethane insulated 0.8 mm (0.031") Type 304 stainless steel flashing with EPDM Base Seal and coated deck flange compatible with roofing system, ARS-500 by Thaler.

.2 Preformed Roof Flashings: 175 mm (7") high, 0.8 mm (0.031", 22 ga.) type 304 stainless steel round flashing, insulated, EPDM Triple Pressure Grommet Seal and EPDM Base Seal, coated deck flange compatible with roofing system, New-Standard SJ 37 by Thaler.

2.4 FABRICATION

.1 Fabricate, assemble and erect manufactured materials in accordance with manufacturer's published specifications for specific types of functions required; manufacturer's specifications are considered to form part of this Section.

.2 Fabricate assemblies complete in every respect, square, true to size and details, and free from distortion, twist or other defects that could affect strength, operation or appearance.

3 Execution

3.1 EXAMINATION

.1 Report in writing defects in adjacent work and other unsatisfactory site conditions that could affect work of this Section.

.2 Verify site dimensions. Commencement of work will imply acceptance of prepared work.

.3 Inspect roof system is properly attached and installed to withstand additional retained loading.

3.2 INSTALLATION

.1 Install in accordance with the manufacturer's written instructions and the contract documents, plumb, true, level and rigid.

.2 Ensure water-tightness continuity of roofing systems.

.3 Adjust and seal assembly with provision for expansion and contraction of components.

.4 Coat metals contact with dissimilar materials, with isolation coating.

.5 Apply full coverage sealant to fastener penetrations at roof surface and underside of through fasten brackets.

3.3 ADJUSTING

.1 Verify that manufactured units are installed in accordance with specifications and details, and will function as intended.

.1 Adjust any items where necessary to ensure proper operation.

3.4 CLEANING

.1 Clean manufactured units using materials and methods approved by manufacturer.

.2 Do not use cleaners or techniques that could impair performance of the roofing system.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this

1.2 SUMMARY

.1 Section Includes:

.1 Prefabricated steel roof hatch, with integral support curbs, safety railings, operable hardware, and counter flashings.

.2 Safety Bar.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings showing construction and anchorage of roof hatches and accessories including, details of all elements of assembly and construction.

.2 Related items shown on shop drawings which are not intended to be supplied as part of the work of this Section, shall be so identified. All dimensions shall be clearly noted and methods of fastening and anchoring detailed. Show accurately and identify all adjacent materials.

.2 Maintenance:

.1 On completion of work of this Section, supply maintenance instructions for insertion into Operating and Maintenance Manual.

1.4 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Use a manufacturer that has completed roof hatch assemblies having similar extent and complexity as required for the Work of this Contract.

.2 Installers Qualifications: Use experienced installers having experience with roof hatch assemblies similar in material, design and extent as required for Work of this Contract with a record of successful in-service performance.

1.5 WARRANTY

.1 Warrant the work of this section in accordance with General Conditions but for a period of two (2) years and agree to repair or replace faulty materials or work which becomes evident during the warranty period without cost to the City and at the City's convenience.

2 Products

2.1 MANUFACTURERS

.1 Basis of Design Products: Products by Acudor Canada specified in this Section were used as the basis of design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section.

.2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Bilco Company

.2 Lexcor

2.2 ROOF HATCHES

.1 Manufactured Units:

.1 Size: Sizes as indicated in the drawing.

.2 Curb: 14 gauge galvanized G90 steel; 1 inch rigid insulation; integral cap flashing to receive roof flashing system; extended flange for mounting.

.3 Cover: 14 gauge galvanized G90 steel with one inch glass fibre insulation retained by 22 gauge steel inner liner. Continuous gasket to provide weatherproof seal.

.4 Hardware: Manufacturer's standard manually operated type with compression spring operators, positive snap latch with turn handles inside and out and padlock hasp inside; automatic holdopen arm with vinyl covered grip handle for easy release; cadmium plated finish.

.5 Hinges: Heavy duty pintle type.

.6 Fasteners: Corrosive resistant fasteners recommended by roof hatch manufacturer.

.7 Basis of Design Material: RHG Ladder Access by Acudor Canada.

2.3 SAFETY ACCESSORIES

.1 Telescoping Safety Post:

.1 Complete with adjustable mounting hardware for securing to any ladder rung size. Unit to be complete with safety bar handle and stainless steel fasteners.

.2 Basis of Design Material: TSP-1 by Acudor Canada.

.2 Safety Rail:

.1 Round, reinforced fire retardant yellow fiberglass treated with a UV inhibitor, complete with Self-closing gate. Provide rail size to match with roof hatch openings.

.3 Hardware:

.1 Mounting brackets shall be 6 mm thick hot dip galvanized steel.

.2 Hinges and post guides: 6063T5 aluminum.

.3 Fasteners: Type 316 stainless steel.

.4 Basis of Design Material: RHSR Safety Rails by Acudor Canada.

2.4 ROOF HATCH LADDER

.1 Steel Wall Ladder: As specified in Section 05 50 00 – Miscellaneous Metals.

2.5 FABRICATION

.1 Fabricate free of visual distortions and defects. Weld corners and joints.

.2 Fabricate units weather tight with integral cap flashing, providing for removal of condensation.

.3 Prime paint; one coat.

.4 Spot weld hasp, latch and hinges to prevent removal from interior.

3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions. Co-ordinate with installation of roofing system and related flashings. Provide weather tight installation.

.2 Apply bituminous paint on metal surfaces of units in contact with cementitious materials and dissimilar metals.

.3 Safety Bar: Install in strict accordance with manufacturer's published instructions.

.4 Safety Rail: Attach hatch rail system to the capflashing of the roof hatch, as recommended by safety rail manufacturer. No penetration of roofing material is required.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements of design, supply and installation of thin film intumescent fire resistant protective coating systems consisting of surface preparation, basecoat and protective decorative finish coat, having a fire resistance rating of 1 hour.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC S101, Fire Endurance Tests of Building Construction and Materials

.2 CAN/ULC S102, Surface burning characteristics of building materials and assemblies

.3 ULC List of Equipment and Materials, latest edition

.3 National Fire Protection Association (NFPA):

.1 NFPA 251, Standard Methods of Fire Tests of Building Construction and Materials

.4 Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers (NACE International):

.1 Coating Materials Guidelines

.2 Surface Preparation Guidelines

.3 SSPC-PA2, Paint Application Specification No.2 - Measurement of Dry Paint Thickness with Magnetic Gages

.5 American Society for Testing of Materials (ASTM):

.1 ASTM E119, Standard Method of Fire Tests of Building Construction and Materials

.2 ASTM E605, Tests for Thickness and Density of Sprayed Fire-Resistive Material Applied to Structural Members

.3 ASTM E736, Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members

.4 ASTM E759, Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members

.5 ASTM E761, Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members

.6 ASTM E859, Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members

1.4 SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit product data including certified copies of test reports verifying fire resistant material applied to substrate as constructed on project will meet or exceed requirements of specification.

.2 Installation Schedule: Submit schedule listing surfaces to which fire resistant material is to be applied indicating minimum thickness required a minimum of one month prior to scheduled application of cementitious fireproofing material.

.3 Manufacturer's Data: Submit manufacturer's specifications and installation instructions.

.4 Samples: Submit 305 mm x 305 mm (12" x 12") samples of intumescent fireproofing system including final finish, for each colour indicated on the Drawings. Indicate location where material/system shall be utilized.

.5 Submit manufacturer's list of approved primers tested for adhesion and compatibility with intumescent fireproofing.

.2 Informational Submittals: Provide the following submittals when requested by the Contract Administrator:

.1 Certificates: Submit test results in accordance with CAN/ULC S101 for fire endurance and CAN/ULC S102 for surface burning characteristics.

.3 Delegated Design Submittals: Provide engineered judgements and certification for work performed by this Section in accordance with requirements of Authority Having Jurisdiction.

.4 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentation in accordance to the following:

.1 Indoor Environmental Quality:

.1 EQ Credit 4.2 - Low-Emitting Materials: Paint and Coatings.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: Use materials and methods required to achieve fire resistance ratings required for the Project to the satisfaction of the Authority Having Jurisdiction, latest edition of the Building Code and in accordance with referenced standards.

.2 Qualifications: Provide proof of qualifications when requested by Contract Administrator:

.1 Applicator: Use applicators that are licensed or approved by manufacturer of fire resistant material.

.1 Certified to National Fireproofing Contractors Association (NFCA) in the Province of the Work.

.1 Accredited to Intumescent Fire-Resistive Materials (IFRM) applications.

.2 Materials: Use materials produced under label service of an agency that has tested material, or assemblies containing material, in accordance with specified test standards.

.3 Air Quality: Provide ventilation in areas receiving fire resistant material during and 24 hours after application to dry material; maintain non-toxic, unpolluted working area; provide temporary enclosure to prevent spray from contaminating air.

.3 Certifications: Provide the following during the course of the Work:

.1 Compliance Certification: Provide certificates from manufacturer indicating tested performance requirements required by Authorities Having Jurisdiction.

.4 Field Inspection: An independent testing agency, hired by the City, to test random samples, as applied, to verify thickness of intumescent fireproofing.

.1 Inspection shall be carried out prior to application of the protective top coat.

1.6 SITE CONDITIONS

.1 Ambient Conditions: Apply fireproofing materials when temperature of substrate and surrounding air is above manufacturer's minimum temperature, provide sufficient ventilation to aid curing of materials and to maintain air quality requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver in original undamaged sealed containers with manufacturer's labels, application instructions, and labelling agencies labels intact.

.2 Storage and Handling Requirements: Store materials in dry protected area, raised off ground and away from damp surfaces and conditions that have deleterious effect on materials; keep materials dry until ready for use; discard material that has been exposed to water before actual use; use stock before its expiration date.

1.8 SEQUENCING AND SCHEDULING

.1 Sequence work in conjunction with structural steel.

.2 Steel surfaces with less than 1 m (3') clear working access may necessitate applying material to inaccessible surfaces prior to erection of the finished steel members, either at the point of fabrication or on-site.

2 Products

2.1 MATERIALS

.1 Interior Intumescent Coating: Low VOC, intumescent coating system consisting of primer, base coat and top coat, approved and listed by ULC or cUL for fire ratings required, flame spread of 25 or less and smoke developed of 50 or less, tested in accordance with ULC S102.

.1 Acceptable Products:

.1 A/D Firefilm III by Carboline Canada.

.2 CAFCO SprayFilm WB 5 by Isolatek International Corp.

.2 Exterior Intumescent Coating: Intumescent coating system, water resistant, consisting of primer, base coat and top coat, approved and listed by ULC or cUL for fire ratings required, flame spread of 25 or less and smoke developed of 50 or less, tested in accordance with ULC S102.

.1 Acceptable Products:

.1 CAFCO SprayFilm WB 4 by Isolatek International Corp.

.2 Or approved alternate by Carboline Canada.

.3 Primer: Compatible with intumescent coating and substrates.

.4 Top Coat: Decorative finish coat, compatible with base coat, manufacturer's standard colour offering.

3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: Verify that materials having a high moisture load that could cause excessive humidity and affect application and drying of intumescent coatings are installed and cured before applying materials of this Section.

.2 Pre-Installation Testing: Test surfaces to receive work of this Section and report any defects that may affect the Work of this Section and to confirm compatibility of surfaces to receive fire resistant materials.

.3 Beginning of installation means acceptance of existing surfaces.

3.2 INSTALLATION

.1 Surfaces to receive fireproofing shall be free of dirt, dust, grease, oil, rust, loose materials, form release agents, frost, moisture or any other matter which would impair the bond of fireproofing material to the substrate. Commercial Blast Cleaning (SSPC-SP6/NACE No. 3) is the recommended minimum requirement for steel surface.

.2 Prime substrates in accordance with manufacturer's written instructions or recommendations. Confine primers to areas of bond; do not allow spillage or migration onto exposed surfaces.

.3 Apply intumescent fire resistant in accordance with manufacturer's instructions in sufficient thickness to achieve fire rating indicated; beginning of application means acceptance of substrate.

.4 Apply intumescent fire resistant and decorative finish using airless spray equipment, brush or roller to achieve smooth, high gloss finish. Orange peel texture and other surface runs or marks arising from painting operations will require remedial action or replacement.

.5 Apply decorative finish and protective seal coat in accordance with manufacturer's recommendations for finish matching approved samples.

.6 Mask where necessary to prevent fireproofing material from contracting adjoining surfaces that will remain exposed upon completion of Work. Remove tape as soon as it is possible to do so, without disturbing the fireproofing material located at the joint between the fireproofing and adjacent substrates.

3.3 FIELD QUALITY CONTROL

.1 Notify Contract Administrator when completed applications are ready for inspection.

.2 Arrange for inspections by the City’s independent inspection and testing company, appointed by the City. Co-ordinate with requirements of Division 01.

.3 Following field inspection, provide all repairs as required to ensure compliance with the Contract Documents.

3.4 CLEANING AND PROTECTION

.1 Upon completion of this work, remove all materials, equipment and debris from the site.

.2 Leave work area and adjacent surfaces in a condition acceptable to the Contract Administrator.

.3 Leave installed work with sufficient protection to enable it to remain untouched until project turnover.

.4 Remove excess material, overspray, droppings and debris.

3.5 PATCHING

.1 Patch and repair any fire resistant material that has been damaged by this or any other section; coordinate cost of repairs with Contractor; costs for repairs will be assessed to Sections of work responsible for damage.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for design, supply and installation of cementitious fireproofing, apply to the structural steel components with the fire resistance rating as indicated in the drawings.

.2 Work of this Section includes, but is not limited to work required to patch, repair and make good after installation of adjacent materials that may cause damage to completed work of this Section.

.3 Structural steel elements that are protected by masonry, concrete, or a rated gypsum board assembly do not require protection using materials specified in this Section provided that protection provided meets required fire resistance as determined from the Building Code.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 American Society for Testing of Materials (ASTM):

.1 ASTM E119, Standard Method of Fire Tests of Building Construction and Materials

.2 ASTM E605, Tests for Thickness and Density of Sprayed FireResistive Material Applied to Structural Members

.3 ASTM E736, Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members

.4 ASTM E759, Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members

.5 ASTM E761, Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members

.6 ASTM E859, Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members

.3 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Build Construction and Materials

.2 CAN/ULC S102 Surface Burning Characteristics of Building Materials and Assemblies

.3 ULC List of Equipment and Materials

.4 National Fire Protection Association (NFPA):

.1 NFPA 251, Standard Methods of Fire Tests of Building Construction and Materials

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordinate installation of hangers, inserts, clips and similar items to surfaces needing protection before applying fireproofing.

.2 Coordinate installation of ducts, pipes, conduits and similar items that could obstruct spraying operations before applying fireproofing.

.3 Coordinate patching of fireproofing after installation of materials installed subsequent to installation of fireproofing.

.4 Delegated Design: Provide engineered judgements and certification for work performed by this Section in accordance with requirements of Authority Having Jurisdiction.

1.5 SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit product data including certified copies of test reports verifying fire resistant material applied to substrate as constructed on project will meet or exceed requirements of specification.

.2 Installation Schedule: Submit schedule listing surfaces to which fire resistant material is to be applied indicating minimum thickness required a minimum of one month prior to scheduled application of cementitious fireproofing material.

.2 Informational Submittals: Provide the following submittals when requested by the Contract Administrator:

.1 Certificates: Submit test results in accordance with CAN/ULC S101 for fire endurance and CAN/ULC S102 for surface burning characteristics.

.3 Sustainable Design Submittals:

.1 LEED Submittals: Submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Recycled Content: provide listing of products incorporating recycled content. Include details of percentages of post-consumer and pre-consumer recycled content for materials and products. Indicate material and product costs.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: Use materials and methods required to achieve fire resistance ratings required for the Project to the satisfaction of the Authority Having Jurisdiction, latest edition of the Building Code and in accordance with referenced standards.

.2 Design Criteria:

.1 Adhesion: Provide materials that meet or exceed adhesion requirements in accordance with ASTM E736.

.2 Thickness and Weight: Determine application thickness and weight of fireproofing based on tests of assemblies in accordance with CAN/ULC S101, ASTM E119 or NFPA 251; apply same thickness of fireproofing material to all structural components forming a part of the assembly including; but not limited to, cross bracing, support angles and hangers.

.3 **Engineered Judgements**: Provide engineered judgment acceptable to Authority Having Jurisdiction where assembly being protected differs from the tested assembly used to determine thickness.

.3 Qualifications: Provide proof of qualifications when requested by Contract Administrator:

.1 Applicator: Use applicators that are licensed or approved by manufacturer of fire resistant material.

.1 Certified to National Fireproofing Contractors Association (NFCA) in the Province of the Work.

.1 Accredited to Sprayed Fire-Resistive Materials (SFRM) applications.

.2 Materials: Use materials produced under label service of an agency that has tested material, or assemblies containing material, in accordance with specified test standards.

.3 Air Quality: Provide ventilation in areas receiving fire resistant material during and 24 hours after application to dry material; maintain nontoxic, unpolluted working area; provide temporary enclosure to prevent spray from contaminating air.

.4 Certifications: Provide the following during the course of the Work:

.1 Compliance Certification: Provide certificates from manufacturer indicating tested performance requirements required by Authorities Having Jurisdiction.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver in original undamaged sealed containers with manufacturer's labels, application instructions, and labelling agency's labels intact.

.2 Storage and Handling Requirements: Store materials in dry protected area, raised off ground and away from damp surfaces and conditions that have deleterious effect on materials; keep materials dry until ready for use; discard material that has been exposed to water before actual use; use stock before its expiration date.

1.8 SITE CONDITIONS

.1 Ambient Conditions: Apply fireproofing materials when temperature of substrate and surrounding air is above manufacturer=s minimum temperature, provide sufficient ventilation to aid curing of materials and to maintain air quality requirements.

2 Products

2.1 APPLIED FIREPROOFING

.1 Water: Clean, fresh, suitable for domestic consumption, and free from such amounts of mineral or organic substance as would affect set of fire resistant material.

.2 Primers: For use on substrate and with each sprayed fireproofing product when recommended by the fireproofing manufacturer. Provide primer that complies with one or more of the following requirements:

.1 Primer listed in ULC Fire Resistance Directory.

.2 Primer's bond strength complies with requirements specified in ULC Fire Resistance Directory, for coating materials based on a series of bond tests in accordance with ASTM E736.

.3 Primer is identical to those used in assemblies listed in ULC design numbers.

.3 Cementitious Fireproofing: Medium density with minimum 240 kg/m^3 (15 pcf), asbestos free, wet mix, containing factory added mould inhibitors to prevent growth of organisms and fungi; acceptable to authorities having jurisdiction, providing fire rating specified

.1 Acceptable Products:

.1 CAFCO 400 by Isolatek International Corp.

.2 Southwest Type 7GP by Carboline Canada.

.3 Monokote Z-106 by GCP Applied Technologies.

3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: Verify that environmental conditions surfaces receiving fireproofing meet manufacturer's requirements before beginning installation products specified in this Section; installation of products will denote acceptance of site conditions.

3.2 PREPARATION

.1 Protection of Existing Conditions:

.1 Provide and maintain temporary enclosures to prevent spray from marring adjacent construction, close off and seal installed duct work to prevent contamination of air supply system.

.2 Provide and maintain masking, drop cloths and polyethylene coverings to protect surfaces exposed in final construction from over spray.

.2 Surface Preparation:

.1 Clean surfaces receiving sprayed fireproofing of oil, grease, dirt, loose paint, mill scale or any other material that could impair bond.

.2 Prime surfaces when required and written in the fireproofing manufacturer's installation instruction, apply primer to the requirement to achieve bond of fireproofing materials to substrates.

3.3 APPLICATION

.1 Apply fireproofing in accordance with manufacturers written installation requirements and as required to obtain fire resistance ratings indicated for the Project.

.2 Apply fireproofing in coats not exceeding recommended by manufacturer for fire resistance ratings indicated for the Project.

.3 Mix each batch of material separately in accordance with manufacturer's instructions to achieve required density and thickness; do not re-temper material or use frozen, caked, or lumpy material.

3.4 SITE QUALITY CONTROL

.1 Perform site testing and inspections with requirements as follows:

.1 The City may appoint third party inspection and testing agency to confirm that installation of fireproofing materials meets requirements of ASTM E605 and ASTM E736-00.

.2 One series of tests will be performed using both laboratory and site testing for each 1000 m^2 of floor area sprayed; patch and repair inspection locations after completion of cut tests.

.3 Test results will be distributed to Contractor and installing Subcontractor at completion of each floor by Contract Administrator.

.2 Non-Conforming Work: Repair deficiencies identified in test results; patch damage to fireproofing caused by other work of the Project before fireproofing is concealed; or if exposed, before substantial performance.

3.5 CLOSEOUT ACTIVITIES

.1 Repairs:

.1 Do repairs before fireproofing is concealed, or if exposed, before final inspection.

.2 Where installed materials is found not to meet performance criteria, remove material and replace with new material to meet specified criteria.

.3 Patch areas where samples have been taken for testing. Match materials and application of adjacent fireproofing.

.2 Cleaning:

.1 Remove equipment and clean exposed wall and floor areas to remove deposits of sprayed fireproofing materials after completion of fireproofing work.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for design, supply and installation of systems comprising firestopping and smoke seal materials and accessories, at joints and penetrations in fire resistance rated wall, floor and roof assemblies, materials and components.

1.3 RELATED REQUIREMENTS

.1 Coordinate with Work of other Sections having a direct bearing on Work of this Section.

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.3 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S115, Standard Method of Fire Tests and Firestop Systems

.2 ULC XHEZC GuideInfo – Firestop Systems

1.5 PERFORMANCE REQUIREMENTS

.1 Materials, accessories and application procedures listed by ULC, cUL, WHI (Intertek/Warnock Hershey) or OPL (Omega Point Laboratories), or tested in accordance with CAN/ULC-S115 to comply with building code requirements.

.2 Fire-Resistive Joint Systems:

.1 Generally, use listed assemblies types F, FT, FH or FTH, as applicable.

.2 Joints at Exterior Curtain-Wall/ Floor Intersections: Use joint systems tested at a positive pressure differential of 2.49 per ASTM E2307.

.3 Firestopping Materials: CAN/ULC-S115 and ASTM E2307, and to achieve fire ratings indicated.

.4 Surface Burning of Exposed Materials: CAN/ULC-S102 with a minimum flame spread/smoke developed rating of 25/50.

.5 Engineering Judgment: Where there is no specific third party tested and classified firestop system available for a particular firestop configuration, provide an Engineering Judgment acceptable to the authority having jurisdiction.

1.6 SUBMITTALS FOR REVIEW

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data: Provide data on product characteristics, performance and limitation criteria, and indicating construction details accurately illustrating Project conditions. Include descriptions sufficient for identification at Project site.

.3 System Design Listings: Submit system design listings including design designations, locations and illustrations, from a qualified testing and inspection agency applicable, to each firestop configuration.

.1 Where Project conditions require modification to a qualified testing agency's illustration for a particular firestopping system condition, submit illustration, with modifications marked, approved by firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire resistance rated assembly.

.4 Firestop System Engineering Judgments: When required for acceptance by the authority having jurisdiction, Firestop System Engineering Judgment submissions shall:

.1 Clearly indicate that the recommended firestop system is an engineering judgment;

.2 Identify the job name, project location and firm which the engineering judgment is issued to.

.3 Be prepared, stamped and signed by a professional engineer, specializing in fire protection and licensed to practice in the place of the work.

.4 Be presented in appropriately descriptive written form with or without detail drawings where appropriate;

.5 Reference tested system(s) which the engineering judgment is based on;

.6 Include clear directions for the installation of the recommended firestop system;

.7 Include dates of issue and authorization signature as well as the issuer’s name, address and telephone number;

.5 Samples:

.1 Submit samples of each type of firestop and smokeseal material and accessory.

1.7 SUBMITTALS FOR INFORMATION

.1 Qualifications Data: For manufacturer and installer.

.2 Installation Data: Manufacturer's special preparation and installation requirements.

.3 Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

.4 Delegated Design Submittals: Design firestopping assemblies required by the Contract Documents to withstand fire ratings indicated and in accordance with the Building Code.

.1 Provide manufacturer’s standard listings where site conditions match standard assembly listing.

.2 Provide manufacturers engineered judgement with acceptance by authorities having jurisdiction, signed and sealed by the manufactures; fire protection engineer where assembly does not match standard assembly listing.

.5 Manufacturer's Field Reports: Indicate environmental conditions under which fireproofing materials were installed. Compatibility and Adhesion Test Reports: From manufacturer indicating the following:

.1 Materials have been tested for bond with substrates.

.2 Materials have been verified by manufacturer to be compatible with substrate.

.3 Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

.6 Sustainable Design Submittals:

.1 LEED Submittals: Submit LEED submittal forms for Credit EQ 4.1 in accordance with the following:

.1 Documentation identifying that VOC content is less than the VOC limits of State of California’s South Coast Air Quality Management District Rule #1168.

1.8 QUALITY ASSURANCE

.1 Applicator shall be licensed by the manufacturer of fireproofing materials.

.1 Accredited Canadian members of the Firestop Contractors International Association (FCIA).

.1 Certified installer listed under the ULC's Qualified Firestop Contractor Program.

.2 Submit manufacturer's certification that materials meet or exceed specified requirements.

.3 Maintain flame and temperature ratings equal to surrounding materials.

.4 Single Responsibility: Perform work using single applicator having undivided responsibility for entire Project, including coordination with plumbing, mechanical and electrical installations.

.5 Single Source Responsibility: Obtain firestop systems for each type of penetration and construction situation from a single primary firestop systems manufacturer.

1.9 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Deliver materials in original, unopened packages bearing name of manufacturer and product identification.

.2 Store materials off ground, under cover, and away from damp surfaces.

1.10 SITE CONDITIONS

.1 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.2 Provide ventilation to manufacturer's instructions in areas to receive solvent cured materials.

2 Products

2.1 FIRESTOP MANUFACTURERS

.1 Subject to compliance with requirements provide products of one of the following manufacturers:

.1 3M Fire Protection Products.

.2 Hilti Canada Ltd.

.3 Specified Technologies Inc.

.4 Tremco Inc.

.5 Emseal Joint Systems Ltd.

2.2 FIRESTOP SYSTEMS

.1 Provide firestop systems to follow ULC XHEZC GuideInfo – Firestop Systems:

.1 Head of Wall Joint Firestop Systems: XHEZC.HW

.2 Joint Firestop Systems: XHEZC.JF

.3 Perimeter Joint Firestop Systems: XHEZC.PJ

.4 Service Penetration Firestop Systems: XHEZC.SP

.5 Service Penetration for Combustible Systems: XHEZC.SPC

2.3 FIRESTOP MATERIALS

.1 Cementitious Matrixes: Minimum 2758 kPa (400 psi) compressive strength when cured, to retard cable tray warping within the firestop seal.

.2 Elastomeric Assemblies: Flexible, elastomeric seal suitable to withstand the required movement and capable of returning to original configuration without damage to seal and without adhesive or cohesive failure.

.3 Primers: Manufacturer's standard for specific material, substrate, and end use.

.4 Water (if applicable): Potable, clean and free from injurious amounts of deleterious substances.

.5 Damming and Backup Materials, Supports and Anchoring Devices: To manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.6 Pipe and Duct Insulation and Wrappings: Compatible with firestopping systems.

.7 Intumescent Pads: Permanently pliable type.

.8 Intumescent Composite Sheet: Composite sheet, strip or precut shapes.

.9 Sealants and Putty For Vertical and Overhead Joints: Non sagging.

.10 Sealants and Fluid Seals at Floors: Self levelling.

.11 Identification Labels: Minimum 75 mm x 100 mm (3” x 4”) permanent self-adhering or mechanically retained corrosion resistant metal labels, with black text on yellow background.

.12 Indicate ULC or cUL firestopping system number, rating, products used, and contact information of installers.

2.4 ACCESSORIES

.1 Provide components for each firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components recommended by firestopping manufacturer in accordance with tested assembly being installed, and acceptable to authorities having jurisdiction.

.2 Primer: Type recommended by firestopping manufacturer for specific substrate surfaces.

.3 Dam Material: Permanent:

.1 Mineral wool board: Minimum 64 kg/m³ density, non-combustible, flame spread of 0, smoke development of 0 to ULC S102.

.2 Mineral wool batt: Minimum 32 kg/m³ density, non-combustible, flame spread of 0, smoke development of 0 to ULC S102.

.3 Alumina silicate fire board.

.4 Sealants used in combination with other forming, damming and backing materials to prevent leakage of fill materials in liquid state.

.5 Fillers for sealants.

.4 Installation Accessories: Clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

.5 Water: Potable, clean and free from injurious amounts of deleterious substances.

3 Execution

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Verify opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping are ready to receive the work of this Section.

.3 Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.

.2 Remove incompatible materials which may affect bond.

.3 Install backing and damming materials to arrest liquid material leakage.

.4 Mask adjacent surfaces to protect from spillage and over coating; immediately remove material from adjacent surfaces.

3.3 APPLICATION

.1 Apply primer and materials to manufacturer's written instructions, approved tested assemblies and details.

.1 Provide materials to maintain the fire separations in the project as indicated on the drawings.

.2 Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

.3 Apply firestopping material in sufficient thickness to achieve rating and to uniform density and texture.

.4 Tool or trowel exposed surfaces to a uniform finish.

.5 Compress fibred material to achieve a density of 25-40 percent of its uncompressed density required for listed system.

.6 Place material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

.7 Place intumescent coating in sufficient coats to achieve rating required.

.8 Remove dam material after firestopping material has cured. Dam material to remain.

.9 Provide identification labels as specified.

.10 In non-fire rated construction indicated to prevent smoke movement, tightly pack voids of service penetrations and around openings with mineral wool insulation and sealant.

3.4 IDENTIFICATION

.1 Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

.1 The words: "Warning: Through-Penetration Firestop System - Do Not Disturb"

.2 Contractor's name, address and telephone number.

.3 Designation of applicable testing and inspection agency.

.4 Date of installation.

.5 Manufacturer's name for firestop materials.

3.5 MANUFACTURER'S SITE SERVICES

.1 Require site attendance of firestopping product manufacturer during installation of the Work. Schedule manufacturer’s review of work procedures at stages listed:

.1 Pre-installation Meeting: 1 review at Site and meeting with authorized Installers.

.2 Installation: 3 reviews at Site: 1 at commencement of Work; 1 at 50% completion of Work; 1 upon completion of Work.

.2 Submit manufacturer's written reports to Contract Administrator describing:

.1 The scope of work requested.

.2 Date, time and location.

.3 Procedures performed.

.4 Observed or detected non-compliances or inconsistencies with manufacturers' recommended instructions.

.5 Limitations or disclaimers regarding the procedures performed.

.6 Obtain reports within three days of review and submit immediately to Contract Administrator.

.3 Monitor and report installation procedures and unacceptable conditions.

.1 Inspect and review materials and workmanship including storage, handling and protection. Advise Contract Administrator and the City 48 hours in advance of inspections.

.2 Correct identified defects or irregularities.

.4 Remove and replace unacceptable firestopping assemblies.

3.6 SITE QUALITY CONTROL

.1 The City will engage an independent testing agency to perform the following special inspections and tests, and prepare reports in accordance with ASTM E2174 and ASTM E2393:

.1 Correct size of joint.

.2 Placement and anchorage of mechanical supports.

.3 Thickness of coatings.

.4 Correct use and location of backings and bond breaker materials.

.5 Adherence testing to verify material bond with substrate.

.2 Testing and inspecting of completed joints and seals shall take place in successive stages, and at a rate not less than one test per day for each Installer and material type. Where deficiencies are found or firestopping is damaged or removed because of testing, repair or replace firestopping to conform to requirements.

.3 Do not proceed with installations for the next area until test results for previously completed installations show conformance to requirements.

.4 Products and materials will be considered defective if they do not pass tests and inspections.

.5 Proceed with enclosing firestopping with other construction only after inspection reports are issued and installations conform to requirements.

.6 Submit testing agency's written reports to Contract Administrator.

3.7 CLEANING

.1 Clean installed work.

.2 Clean adjacent surfaces of firestopping materials.

3.8 PROTECTION OF FINISHED WORK

.1 Protect installed work.

.2 Protect adjacent surfaces from damage by material installation.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Sealants and joint backing.

.2 Acoustic sealants.

.3 Compressible seals.

.4 Site quality control and manufacturer's site services.

1.3 RELATED REQUIREMENTS

.1 Coordinate with Work of other Sections having a direct bearing on Work of this Section.

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM C509, Standard Specifications for Elastomeric Cellular Performed Gasket and Sealing Material

.2 ASTM C510, Standard Test Method for Staining and Color Change of Single-or Multicomponent Joint Sealants.

.3 ASTM C920, Standard Specification for Elastomeric Joint Sealants.

.4 ASTM C1021, Standard Practice for Laboratories Engaged in Testing of Building Sealants.

.5 ASTM C1184, Standard Specification for Structural Silicone Sealants.

.6 ASTM C1193, Standard Guide for Use of Joint Sealants.

.7 ASTM C1248, Standard Test Method for Staining of Porous Substrate by Joint Sealants.

.8 ASTM C1330, Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.

.9 ASTM D5893/D5893M, Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

1.5 SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Manufacturer's Data: Submit manufacturer's literature describing each material to be used in the work of this Section. Literature shall contain a statement that the material complies with the specified standard.

.2 Structural Sealant Joint Design: Provide calculations for structural bite, dead load support, glueline thickness, shear, and other parameters. Include confirmation that

design data provided by Contract Administrator have been reviewed and approved by sealant manufacturer.

.3 Samples: Submit for approval and colour selection sample of each type of compound, recommended primers and joint filler or fillers proposed to be used.

.2 Submittals for Information:

.1 Qualifications Data: For Manufacturer and Installer.

.2 Installation Data: Manufacturer's special installation requirements.

.1 Indicate special procedures, surface preparation, perimeter conditions requiring special attention, and field quality control testing.

.3 Field reports.

.1 Site quality control report identifying procedures for site testing and verification.

.2 Manufacture site service report identifying materials have been installed in accordance with manufactures recommendations.

.3 Sustainable Design Submittals:

.1 LEED Submittals: Submit LEED submittal forms for Credit EQ 4.1 in accordance with the following:

.1 Documentation identifying that VOC content is less than the VOC limits of State of California's South Coast Air Quality Management District Rule #1168.

1.6 QUALITY ASSURANCE

.1 Applicator qualifications:

.1 Execute Work by applicators trained and approved by the manufacturer and having 5 years proven experience.

.2 Independent inspection and testing agency:

.1 Qualification: In accordance with ASTM C1021.

.2 Conduct field inspection and testing of sealant with the manufacturer's representative for a minimum of 20% of joints, including mixing of materials, joint preparation, priming, joint profile and thickness, application, adhesion, cohesion, and tooling.

.3 Prepare and submit inspection and test report results after each inspection. Include confirmation by the manufacturer that installation has been satisfactorily completed.

.3 Manufacturer's representative:

.1 Review Site conditions, joint design, and installer's qualifications. Report unsatisfactory conditions to Contract Administrator.

.2 Check container labels, inspect preparation of substrate materials and review installation procedures 48 hours in advance of installation, and randomly test installed Work.

.4 Mock-up:

.1 Construct mock-up for each type of sealant to show location, size, shape, colours, and depth of joints complete with bond breaker, joint backing, primer, and sealant. Accepted mock-up may become part of finished Work.

.2 Remove mock-ups that do not form part of Work from Site during final cleanup, or when directed by Contract Administrator.

.3 Allow 48 hours for Contract Administrator to review mock-up before proceeding with sealant Work.

.5 Pre-installation meetings:

.1 Conduct meetings 7 Days in advance of sealant installation.

.2 Include Contract Administrator, sealant manufacturer's representative, independent inspection and testing agency engaged by Contractor, and parties who are directly affected by the Work of this Section.

.3 Verify Contract requirements, substrate conditions, joint conditions and profile, weather conditions, and the manufacturer's installation instructions.

.4 Within 72 hours following the pre-installation meeting, prepare a pre-installation meeting report and issue to all parties in attendance.

.1 Clearly indicate the recommendations made during the pre-installation meeting, the required actions, and by whom.

1.7 SITE CONDITIONS

.1 Apply sealants only to completely dry surfaces, and at air, substrate and material temperatures above minimum established by manufacturer's written specifications.

1.8 DELIVERY, STORAGE HANDLING AND PROTECTION

.1 Deliver all materials to the jobsite in their original, unopened containers, with all labels intact.

.2 Receive and store materials as recommended by materials manufacturer.

.3 Maintain containers and labels in undamaged condition.

1.9 WARRANTY

.1 Provide a five (5) year warranty to include coverage for failure to meet specified requirements.

.1 Include coverage for installed sealants and accessories which fail to achieve air tight seal, water tight seal, and exhibit loss of adhesion or cohesion, or do not cure.

.2 Provide manufacturer's twenty-year material warranty for installed silicone sealant.

2 Products

2.1 MATERIALS – SEALANTS

.1 Type A:

.1 Single component, non-sag, non-paintable, silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class 25, and nonstaining when tested in accordance with ASTM C510 or ASTM C1248.

.2 Colour:

.1 To match adjacent substrate.

.3 Manufacturer's Products:

.1 DOWSIL™ Contractors Weatherproofing Sealant (CWS) by Dow.

.2 Tremsil 400 by Tremco Sealants.

.3 Sikasil-N plus by Sika Canada Inc.

.4 SWS by GE Silicones.

.5 Pecora PCS by Pecora Corporation.

.2 Type B:

.1 Silicone joint sealant, in accordance with ASTM D5893/D5893M and nonstaining when tested in accordance with ASTM C510 or ASTM C1248.

.2 Colour:

.1 To match adjacent substrate.

.3 Manufacturer's Products:

.1 Contractors Concrete Sealant (CCS) by Dow.

.2 Spectrem 900 SL by Tremco Sealants.

.3 Sikasil 728 SL by Sika Canada Inc.

.4 300SL by Pecora Corporation.

.3 Type C:

.1 Anti-microbial (mildew-resistant), non-paintable, silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class 25, and nonstaining when tested in accordance with ASTM C510 or ASTM C1248.

.2 Colour:

.1 Clear/translucent.

.3 Manufacturer's Products:

.1 DOWSIL 786 by Dow.

.2 Tremsil 200 by Tremco Sealants.

.3 SikasilGP/GP HT by Sika Canada Inc.

.4 SCS1700 Sanitary by GE Silicones.

.5 Pecora 898NST by Pecora Corporation.

.4 Type D:

.1 Silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class 50, and nonstaining when tested in accordance with ASTM C510 or ASTM C1248. Suitable for structural glazing in accordance with ASTM C1184.

.2 Colour:

.1 To match adjacent substrate.

.3 Manufacturer's Products:

.1 DOWSIL 795 by Dow.

.2 Spectrem 2 by Tremco Sealants.

.3 Sikasil WS295 by Sika Canada Inc.

.4 SCS2000 SilPruf by GE Silicones.

.5 Pecora 895NST by Pecora Corporation.

.6 Pecora 890NST by Pecora Corporation.

.5 Type F:

.1 Low dirt pick-up, silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class 50, and nonstaining when tested in accordance with ASTM C510 or ASTM C1248.

.2 Colour:

.1 To match adjacent substrate.

.3 Manufacturer's Products:

.1 DOWSIL 756 by Dow.

.2 Spectrem 3 by Tremco Sealants.

.3 Sikasil WS-295 by Sika Canada Inc.

.4 SCS9000 Silpruf NB by GE Silicones.

.5 Pecora 864NST by Pecora Corporation.

.6 Type G:

.1 Silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class 50, and nonstaining in accordance with ASTM C510 or ASTM C1248. General purpose type.

.2 Colour:

.1 To match adjacent substrate.

.3 Manufacturer's Products:

.1 DOWSIL Contractors Weatherproofing Sealant (CWS) by Dow.

.2 Tremsil 200 by Tremco Sealants.

.3 Sikasil WS-295 by Sika Canada Inc.

.4 SCS 1000 Contractors by GE Silicones.

.5 Pecora PCS by Pecora Corporation.

.7 Firestopping and Smoke Seals:

.1 Refer to Section 07 84 00 – Firestopping and Smokeseals.

2.2 COMPRESSIBLE SEAL

.1 Exterior Compressible seal:

.1 Silicone pre-coated, preformed, pre-compressed, self-expanding, binary sealant system of expanding polyurethane foam impregnated with water based, stabilized, polymer modified acrylic with factory applied silicone coated bellows, complete with field applied liquid silicone corner bead in matching colour, depth of seal as recommended by manufacturer. Use factory fabricated transitions and terminations pieces where joints change plane.

.1 Seismic Colorseal by Emseal Corporation, standard colour.

.2 Acoustic compressible seals:

.1 Preformed Foam Joint Sealant: Manufacturer's standard. Preformed, pre-compressed, open-cell foam sealant manufactured from urethane foam. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated.

.2 Acoustic compressible seals: coated on 2 sides for joints between opaque surfaces, coated on 3 sides for compression against clear surfaces.

.3 Product:

.1 At opaque materials: QuietJoint SHH by Emseal Corporation, or approved alternate.

.2 At clear materials: QuietJoint SHG by Emseal Corporation, or approved alternate.

2.3 ACOUSTIC SEALANT

.1 To ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.2 Product: Subject to compliance with requirements of this Section provide one of the following products:

.1 CP-506 by Hilti.

.2 Sheetrock Brand Acoustical Sealant by USG.

.3 AC-20 FTR or AIS-919 by Pecora; product as recommended by manufacturer for application indicated.

.3 Accessories: As recommended by manufacturer to achieve minimum STC rating listed.

2.4 ACCESSORIES

.1 Primers:

.1 Type recommended by sealant manufacturer for substrate, to promote adhesion and to prevent staining of adjacent surfaces for conditions encountered.

.2 Joint backing:

.1 Extruded, round, solid section, skinned surface, closed cell, soft polyethylene foam gasket stock, compatible with primer and sealant materials.

.2 30% to 50% oversized.

.3 Shore A hardness of 20, tensile strength 140 kPa to 200 kPa, in accordance with ASTM C1330.

.4 Bond breaker type surface.

.3 Bond breaker tape:

.1 Polyethylene tape or other plastic tape recommended by sealant manufacturer to prevent sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint.

.2 Provide self-adhesive, pressure sensitive tape where applicable.

.3 Do not use material impregnated with oil, bitumen, non-curing polymer or similar deleterious material.

.4 Cleaning agents:

.1 Recommended by sealant manufacturer.

.2 Free of oily residues or other substances capable of staining or harming joint substrates and adjacent surfaces.

.5 Masking tape:

.1 Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

3 Execution

3.1 INSPECTION

.1 Verify at site that joints and surfaces conditions provided will not adversely affect execution, performance or quality of completed work.

.2 Ensure masonry and concrete have cured 28 days minimum.

.3 Ascertain that sealers and coatings applied to substrates are compatible with sealant used and that full bond of the sealant and substrate is attained. Request samples of the sealed or coated substrate from their fabricators for testing of compatibility and adhesion, if necessary.

.4 Verify that specified recommended environmental conditions are present before commending work.

.5 Defective work resulting from application to unsatisfactory joint conditions will be considered the responsibility of those performing the work of this section.

.6 Do not start work of this Section until conditions are satisfactory.

3.2 PREPARATION

.1 Clean joint surfaces using joint cleaner as necessary, to remove dust, paint, loose mortar, and other foreign matter and dry joint surfaces.

.2 Remove dust, silt, scale and coatings from ferrous metals by wire brush, grinding or sandblasting.

.3 Remove oil, grease and other coatings from non-ferrous metals with approved cleaning solvent.

.4 Ensure surfaces are free of frost, rust, lacquers, laitance, release agents, moisture or other matter which might adversely affect adhesion of sealant.

.5 Examine joint sizes and correct as required to allow for anticipated movement and to achieve proper width/depth ratio per manufacturer's written recommendations for specified sealant.

.6 Support joint filler on horizontal traffic surfaces against vertical movement which might result from traffic loads or foot traffic.

.7 Prepare surfaces as recommended by sealant manufacturer.

.8 Fully remove existing sealant scheduled to be removed and replaced with new sealant, in areas indicated on the Drawings.

.1 Follow manufacturers procedures for removal of existing sealant and test areas for adhesion of new sealant. Provide the Contract Administrator with field report identifying results of adhesion testing.

.9 Install joint backing material or apply bond breaker tape to achieve correct joint depth and prevent three-sided adhesion.

.10 To protect adjacent surfaces, mask adjacent surfaces with tape prior to priming and/or sealing.

.11 Prime sides of joints using two cloth method in accordance with manufacturer's directions immediately prior to sealing.

.12 Before any sealing is commended, a test of the material shall be made for indications of staining, poor adhesion or other undesirable effects.

.13 Seal joints in surfaces to be painted before painting. Where surfaces to be sealed are prime painted in shop before sealing, check to make sure prime paint is compatible with primer and sealant. If incompatible inform Contract Administrator, consult the manufacturer, and change primer and sealant to approved compatible types.

.14 Check form release agent used on concrete for compatibility with primer and sealant. If incompatible inform Contract Administrator and change primer and sealant to approved compatible types or clean concrete to Contract Administrator’s approval.

3.3 INSTALLATION

.1 Perform Work in accordance with manufacturer's recommendations for Products and applications indicated, unless more stringent requirements apply.

.2 Use Products without additives or adulteration. Use one manufacturer's Product for each location in accordance with Sealant Location Schedule at end of this section.

.3 Perform Work in accordance with ASTM C1193, and ASTM C919 for Acoustic Sealant.

.4 Joint backing:

.1 Install joint backing to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

.1 Depth of recess: Maintain 2:1 joint width to depth ratio.

.2 Where recess is less than specified depth, cut back surface of recess to specified depth.

.2 Do not leave gaps between ends of joint backings.

.3 Do not stretch, twist, puncture, or tear joint backings.

.4 Remove absorbent joint backings that have become wet before sealant application and replace with dry materials.

.5 Support joint backing on horizontal surfaces against vertical movement which might result from pedestrian or vehicular traffic loads.

.5 Install bond breaker tape between sealant and back of joints where joint backing is not used.

.6 Apply sealant immediately after adjoining Work is in condition to receive sealant Work and as follows:

.1 Apply sealant in a continuous bead using gun with correctly sized nozzle. Use sufficient pressure to completely fill joint recess.

.2 Ensure sealant has full, direct uniform contact with, and adhesion to, side surfaces of recess. Superficial pointing with skin bead is not acceptable.

.7 Tooling:

.1 Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified to form smooth, uniform sealant bead, free from ridges, wrinkles, sags, air pockets, embedded impurities, dirt, stains, or other defects.

.2 At recesses in angular surfaces, finish sealant with flat profile, flush with face of material at each side.

.3 At recesses in flush surfaces, finish sealant with concave face and flush with face of material at each side.

.8 Immediately remove excess sealant and droppings.

.9 Ensure sealant bead is uniform in colour.

.10 Cure in accordance with the sealant manufacturer's recommendations. Do not cover up sealants until proper curing has taken place.

.11 Remove defective sealant and reapply.

3.4 SITE QUALITY CONTROL

.1 Joint Sealants: Perform adhesion tests on exterior sealants in accordance with manufacturer's written instructions and ASTM C1193, Method A – Field-Applied Sealant Joint Hand Pull Tab.

.1 Perform test no later than 21 days after installation at a rate of one test every 300 m of installed sealant.

.2 Structural Sealant: Perform adhesion tests on exterior sealants in accordance with manufacturer's written instructions and ASTM C1401, Method B – Hand-Pull Tab (Non-destructive).

.1 Perform five tests for first 300 meters of applied silicone sealant and one test for each 300 meters seal thereafter or perform one test per floor per building elevation minimum.

.2 For sealant applied between dissimilar materials, test both sides of joint.

.3 Remove sealants failing adhesion test, clean substrates, reinstall sealants and perform retesting.

.4 Maintain test log and submit report to Contract Administrator indicating tests, locations, dates, results, and remedial actions.

.5 Maintain record of conditions and temperatures during application.

3.5 MANUFACTURER'S SITE SERVICES

.1 Require site attendance of each sealant manufacturers, during installation of the Work. Start sealant application in presence of manufacturer's technical representative.

.2 Monitor and report installation procedures and unacceptable conditions.

3.6 CLEANING

.1 Clean surfaces adjacent to joints. Immediately remove sealant smears or other soiling resulting from application of sealants.

.2 Remove masking tape and other residue.

.3 Do not mar or damage finishes on materials adjacent to joints. Repair or replace marred or damaged materials.

3.7 PROTECTION

.1 Protect joint sealants:

.1 During and after curing period from contact with contaminating substrates.

.2 From damages by construction operations or other causes.

.2 If damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated sealants immediately.

3.8 SEALANT LOCATIONS SCHEDULE

Type A	Above grade level, vertical applications
	- General perimeter caulking (window, doors and frames, louver frames, shelf angles, thresholds, bedding of mullions, precast and tilt-up panels). - Vertical expansion, control, lap joints application. - Painted metals. - Mullion joints. - Interior partition head to structure above.

Type A	Above grade level, vertical applications
	- Interior metal frames joints. - Exterior metal flashing. - Locations not indicated on Contract Drawings and required sealant for Work.

Type B	Above grade level, horizontal applications
	- Horizontal expansion joints. - Saw cut horizontal joints. - Precast slab horizontal joints. - Horizontal expansion and control joints in parking garages, floors, and sidewalks.

Type C	Above grade level, horizontal and vertical applications
	- Around sinks, urinals, and bathroom fixtures. - Tiled areas' horizontal and vertical control and expansion joints. - Between vanity and mechanical fixtures/fittings. - Between access panels and tiles. - At corners of tiled walls.

Type D	Above grade level, horizontal and vertical applications
	- Structural attachment of panel systems, horizontal and vertical. - Panel stiffener applications. - Suitable for wood, vinyl, and aluminum surfaces.

Type F	Above grade level, horizontal and vertical applications
	- Required non-staining to building materials. - Expansion and control joints in concrete panels, non-staining to building materials is required. - Metal curtain wall. - Exterior and interior metal panels. - Masonry, where non-staining to building materials is required.

Type G	Above grade level, both vertical and horizontal
	- Glazing but not structural glazing. - Conventional glazing and replacement glazing of glass and plastic. - Aluminum sheet cover for insulation on metal pipes in exterior locations.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of expansion control systems including but not limited to, the following:

.1 Expansion joint cover system.

.2 Foam seal expansion joint system.

.3 Waterproofing expansion joint system.

.4 Fire rated expansion joint system.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 DESIGN CRITERIA

.1 Fire rated expansion joints: Conform to criteria outlined in Section 07 84 00 – Firestopping and Smokeseals. Ensure expansion control systems with fire barriers identical to those of systems tested for fire resistance CAN/ULC-S101, and to achieve fire ratings indicated.

.2 Seismic performance: Expansion control systems shall withstand the effects of earthquake motions determined in accordance with requirements of applicable code.

.3 Joint movement capability: Provide expansion control systems with movement capability as specified Structural Contract Administrator’s specifications or as indicated, but not less than plus or minus 50 percent of joint width, without detrimental effects to assembly and adjacent construction.

.4 Design expansion joints to Withstanding loads and of accommodating movement, and the other functions for which they are designed including those specified below, without failure.

.1 Vertical Exterior Joints: Maintain continuity of weather enclosure.

.2 Joints in Fire Resistance Rated Assemblies: Maintain fire resistance ratings of assemblies.

.3 Other Joints: Where indicated, provide joint systems that prevent penetration of water, moisture, and other substances deleterious to building components or content.

1.5 SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.

.2 Shop Drawings: Indicate joint and splice locations, mitres, layout of the work, line diagrams showing entire route of each expansion control system, affected adjacent construction, anchorage locations, and include a product schedule prepared by or under the supervision of the supplier. Include the following information in tabular form:

.1 Manufacturer and model number for each expansion control system.

.2 Expansion control system location cross-referenced to Drawings.

.3 Nominal joint width.

.4 Movement capability.

.5 Classification as thermal or seismic.

.6 Materials, colours, and finishes.

.7 Product options.

.8 Fire-resistance ratings where indicated.

.3 Samples for Verification: Full size units 150mm (6") long of each type of joint system indicated; in sets for each finish, colour, texture, and pattern specified, showing the full range of variations expected in these characteristics.

.2 Informational Submittals: Provide the following submittals when requested by the Contract Administrator:

.1 Certificates: Submit certificate signed by manufacturer indicating that Products supplied for work of this Section are appropriate for expected range of performance including engineered judgements for fire rated products not tested to meet ULC requirements.

.2 Source Quality Control Submittals: Submit testing data from a qualified testing agency indicating that expansion control systems meet range of movement and exposure requirements for Project, based on comprehensive testing of current products.

.3 Sustainable Design Submittals:

.1 Sustainability Characteristics: Submit products meet following LEED® performance criteria of the following:

.1 Regional materials.

.2 Low-Emitting Materials (CDPH/EHLB/Standard Method Version 1.2-2107) Certificate.

.3 USGBC LEED Version 4: EQ Indoor Air Quality, Credit: Low-Emitting Materials

.4 Green Guide for Healthcare V2.2

1.6 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate compatibility of products supplied by this Section with adjoining joint systems specified in other Sections.

.2 Pre-Construction Meeting: Conduct a meeting before starting any concrete or waterproofing work with attendance by Contractor, Subcontractor for work of this Section, Subcontractor's for work affected by this Section to discuss the following:

.1 Expansion joint placement and alignment, and installation of block outs

.2 Establishing minimum nominal joint width to suit ambient conditions at time of installation of expansion joint materials.

.3 Protection of expansion joints during construction and after installation of expansion joint materials

.4 Include follow-up agenda item for subsequent progress meetings to identify ongoing coordination and responsibilities relating to installation of expansion joints.

1.7 WARRANTY

.1 Provide five (5) year warranty by each manufacturer of expansion joint assemblies covering defects in products and failure to meet specified requirements.

.2 Warranty: Coverage for separation of seals, distortion, and visible defects in finishes.

2 Products

2.1 APPROVED MANUFACTURERS

.1 Specified Products: Product specified is product by Sika Emseal. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

2.2 EXPANSION JOINT SYSTEM – GENERAL

.1 Provide joint systems of design, basic profile, materials, and operation indicated.

.2 Provide units that can accommodate joint widths indicated including alignment variations in adjacent surfaces, and as follows:

.1 Provide units in longest practicable lengths to minimize number of end joints. Provide hairline mitred corners where joint changes directions or abuts other materials.

.2 Include closure materials and transition pieces, tee joints, corners, curbs, cross connections, and other accessories as required to provide continuous joint systems.

.3 Public Area Seals: Nonslip seals designed to lie flat with adjacent surfaces, and complying with handicapped accessibility guidelines for public areas.

2.3 EXPANSION JOINT COVER SYSTEMS

.1 Fire Rated Floor-to-Floor Joint Systems (EJ-F1):

.1 Cover Plate: Extruded aluminium serrated finish cover plate anchor to central spline with stainless steel self tapping screw

.2 Joint Filler: UL and cUL certified fire retardant impregnated foam seal.

.3 Size as indicated in the drawings.

.4 Basis of Design Product:

.1 1 hour rated: SJS FR1 by Sika Emseal.

.2 2 hour rated: SJS FR2 by Sika Emseal.

.2 Wall-to-Wall and Ceiling to Ceiling (EJ-W1):

.1 Preformed and expanding, precoated silicone and impregnated foam seal.

.2 Basis of Design Product: Seismic Colorseal by Sika Emseal.

.1 To match adjacent wall finish, to be selected by Contract Administrator from product standard colour chart.

.3 Fire Rated Wall-to-Wall (EJ-W2):

.1 Preformed and expanding, UL and cUL certified fire retardant impregnated foam seal.

.2 Basis of Design Product:

.1 1 hour rated: Emshield WFR1 by Sika Emseal.

.2 2 hour rated: Emshield WFR2 by Sika Emseal.

.3 3 hour rated: Emshield WFR3 by Sika Emseal.

.4 Colour: To match adjacent wall finish, to be selected by Contract Administrator from product standard colour chart.

.4 Roof Expansion Joint Cover (EJ-R1):

.1 Extruded, dual-seal, double-flanged, thermoplastic rubber system. Allow transitioning between the joint in the roof and joints in walls.

.2 Basis of Design Product: RoofJoint by Sika Emseal.

2.4 MATERIALS

.1 Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

.2 Aluminum Extrusions: AA6063-T6 and AA6063-T5 alloy, conforming to ASTM B221-92a.

.3 Fasteners: Plated steel; size and length to suit.

.4 Bituminous Paint: Conforming to CAN/CGSB-1.108, Type 2.

2.5 FINISHES

.1 Aluminum Finishes:

.1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

.2 Class II, Clear Anodic Finish: AAM12C22A31 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

2.6 FABRICATION

.1 Fabricate components in longest practicable lengths.

.2 Prefabricate corners and other intersection pieces.

.3 Resilient gasket filler strips shall be key locked or bonded to aluminum retainers.

.4 Select width of assemblies to suit expansion joint size, unless otherwise shown assume 51 mm (2") wide joints.

3 Execution

3.1 PREPARATION

.1 Prepare substrates according to expansion control system manufacturers written instructions.

.2 Examine expansion joints for the presence of voids, honeycombing, spalling and to confirm joint dimensions. Report in writing all errors, discrepancies, and deficiencies to the Contract Administrator.

.3 Clean joints, ensuring that they are clean, dry, free of dust, dirt, loose materials, grease, oil, and other foreign materials detrimental to installation of expansion joint assemblies.

.4 Fastening to InPlace Construction: Provide anchorage devices and fasteners where necessary to secure joint systems to inplace construction, including threaded fasteners with drilledin expansion shields for concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

3.2 INSTALLATION

.1 Comply with manufacturer's written instructions for handling and installing expansion control assemblies and materials, unless more stringent requirements are indicated.

.2 Coordinate installation of expansion control assembly materials and associated work so complete assemblies comply with assembly performance requirements.

.3 Terminate exposed ends of exterior expansion control assemblies with factory fabricated termination devices to maintain waterproof system.

.4 Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required to install joint systems.

.1 Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.

.2 Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.

.3 Locate covers in continuous contact with adjacent surfaces.

.4 Securely attach in place with required accessories.

.5 Locate anchors at interval recommended by manufacturer, but not less than 76 mm (3”) from each end and not more than 610 mm (24”) $^{O}/_{C}$.

.5 Maintain continuity of joint systems with a minimum number of end joints and align metal members.

.6 Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames.

.7 Adhere flexible filler materials, if any, to frames with adhesive or pressure sensitive tape as recommended by manufacturer.

.8 Preformed Foam Joint System: Install preformed foam joint system in accordance with manufacturer’s instructions; clean expansion control joint and silicone surfaces of foam joint system to remove deleterious materials; apply sealants to ends, edge and fillets.

.9 Install fire rated system to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and end joints.

3.3 CLOSEOUT ACTIVITIES

.1 Protecting: Do not remove protective covering until finish work in adjacent areas is complete; clean exposed metal surfaces to comply with manufacturer's written instructions when protective covering is removed.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of the following:

.1 Exterior and Interior Steel Doors and Frames

.2 Sidelight Frames

.3 Fire Rated Steel Door and Frame Assemblies

1.3 DEFINITIONS

.1 Base Metal Thickness: Thickness dimensions are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic coated steel sheets.

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.3 American National Standards Institute (ANSI):

.1 ANSI/SDI A250.7, Nomenclature for Standard Steel Doors and Steel Frames

.2 ANSI/SDI A250.11, Recommended Erection Instructions for Steel Frames.

.4 American Society for Testing and Materials (ASTM):

.1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.2 ASTM A879/A879M, Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

.3 ASTM A924/A924M, Standard Specification for General Requirements for Sheet Steel, Metallic-Coated by the Hot-Dip Process.

.4 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.5 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 1.132-M90, Primer, Zinc Chromate, Low Moisture Sensitivity

.2 CAN/CGSB 41-GP-19Ma, Rigid Vinyl Extrusions for Windows and Doors

.3 CAN/CGSB 82.5-M88, Insulated Steel Doors

.6 Canadian Standards Association (CSA):

.1 CSA W59, Welded Steel Construction (Metal Arc Welding)

.7 Canadian Steel Door Manufacturers Association (CSDMA):

.1 Recommended Dimensional Standards for Commercial Steel Doors and Frames

.2 Fire Labelling Guide

.8 National Fire Protection Association (NFPA):

.1 NFPA 80, Standard for Fire Doors and Other Opening Protectives

.2 NFPA 252, Standard Methods of Fire Tests of Door Assemblies

.9 Underwriters Laboratories Canada (ULC):

.1 CAN4 S104, Standard Method for Fire Tests of Door Assemblies

.2 CAN/ULC-S105, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.

.3 CAN/ULC-S701.1, Standard for Thermal Insulation, Polystyrene Boards.

1.5 DESIGN REQUIREMENTS

.1 Design exterior frame assemblies to accommodate expansion and contraction when subjected to minimum and maximum surface temperature of 35 dgree C to 35 degree C.

.2 Maximum deflection for exterior steel entrances, screens and transoms under wind load of 1.2 kPa not to exceed 1/175th of span.

1.6 SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data:

.1 Submit product data for each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, fire resistance ratings, and finishes.

.2 Shop Drawings:

.1 Show each type of frame, door, hardware blanking, reinforcing, tapping and drilling arrangements, metal gauges, thicknesses and finishes.

.2 Show details of doors including vertical and horizontal edge details.

.3 Submit door and frame schedule identifying each unit. Each unit shall bear a legible identifying mark corresponding to that listed in the door and frame schedule.

.3 Samples:

.1 Supply for Contract Administrator's review, if requested, sample of frame corner showing construction, workmanship and finish.

.4 Informational Submittals: Provide the following submittals when requested by the Contract Administrator:

.1 Source Quality Control Submittals: Submit information on zinc coating treatment and primer spot treatment, including instructions for surface treatment before site painting and any restrictions or special coating requirements.

.5 Certificates: Submit the following certificates or letters of compliance:

.1 Oversize Compliance: Submit oversize construction evidence indicating compliance with fire labelling for door and frame assemblies required to be fire protection rated and exceeding size limitations of labelled assemblies.

.2 Sustainable Design Submittals:

.1 LEED Submittals: submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Recycled Content: provide listing of products incorporating recycled content. Include details of percentages of post-consumer and pre-consumer recycled content for materials and products. Indicate material and product costs.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20% of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project.

.3 Submit product data for site applied touch-up primer for interior applications verifying compliance with GC-03, Green Seal Environmental Criteria for Anti-Corrosive Paints, for VOC content.

.4 Submit shop paint primer manufacturer's product data verifying compliance with MPI Green Performance Standard GPS-1-08, for VOC content.

1.7 QUALITY ASSURANCE

.1 Manufacturer: Obtain hollow metal doors and frames from single source of supply and from a single manufacturer, and as follows:

.1 Fabricate work of this Section to meet the requirements of the Canadian Steel Door and Frame Manufacturer's Association, Manufacturing Specification for Doors and Frames as a minimum, and as further modified in this section.

.2 Fabricator shall be a member in good standing of the Canadian Steel Door and Frame Manufacturer's Association.

.2 Supplier: Obtain hollow metal doors and frames from single source of supply and from a single manufacturer.

.3 Installer: Use installers who are experienced with the installation of hollow metal doors and frames of similar complexity and extent to that required for the Project. Comply with requirements of Canadian Steel Door Manufacturers' Association.

.4 Testing Agencies: Provide doors produced under label service program of a testing agency acceptable to Authorities Having Jurisdiction, and as follows:

.1 Steel Fire Rated Doors and Frames: Labelled and listed by an organization accredited by Standards Council of Canada for ratings specified or indicated.

.2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:

.1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

.2 Fabricate all rated doors, frames and screens to labelling authority standard.

1.8 REQUIREMENTS OF REGULATORY AGENCIES

.1 Fire Protection Rated Assemblies: Labelled and listed by a nationally recognized testing agency having factory inspection service in conformance with CAN/ULC S104 and CAN/ULC S105 for fire protection ratings indicated.

.2 Oversize Fire Protection Rated Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with construction requirements for tested and labeled fire protection rated assemblies except for size.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off-the-ground, under cover storage location. Do not load any area beyond the design limits.

.2 Adequately protect units against rust and damage during manufacture, delivery and storage.

.3 Store materials on planks in a dry area and cover to protect from damage. Make good immediately any damage done. Clean scratches and touch-up with rust-inhibitive primer.

.4 Brace and protect doors and frames to prevent distortion during shipment.

.5 Store doors vertically, resting on planks, with blocking between to allow air to circulate.

2 Products

2.1 MATERIALS

.1 Metallic Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum ZF180 zinc-iron-alloy (galvannealed) coating designation.

.2 Minimum Core Thickness: Metallic coated sheet steel without coating.

.1 Door and Sidelight Frames: 1.519 mm (0.060”).

.2 Doors and Panels, Stiffened Hollow Steel Construction

.1 Face Sheets: 1.519 mm (0.060”).

.2 Vertical Stiffeners: 0.912 mm (0.036”).

.3 Lock and Strike Reinforcements: 2.66 mm (0.1”).

.4 Hinge and Pivot Reinforcements: 3.416 mm (0.134”) thick by 38 mm (1-1/2”) wide by 150 mm (6”) longer than hinge and pivot, secured by not less than 6 spot welds.

.5 Flush Bolt Reinforcement: 2.66 mm (0.1”).

.6 Surface Applied Hardware Reinforcements : 2.66 mm (0.1”).

.7 Closer or Holder Reinforcements: 2.66 mm (0.1”).

.8 Glazing Stops: 0.912 mm (0.036”).

.9 Top and Bottom End Channels and Caps: 1.6 mm (0.060”).

.10 Mortar Guard Boxes: 0.759 mm (0.03”).

.11 Floor Anchors: 1.6 mm (0.060”).

.12 Jamb Spreaders: 0.912 mm (0.036”).

.13 Frame Anchors:

.1 Masonry T Strap: 1.214 mm (0.048”).

.2 In-Place Masonry/Concrete: 0.912 mm (0.036”).

.3 Steel Stud: 0.912 mm (0.036”).

.3 Insulation Core: Fibreglass to CAN/ULC S702, semi rigid.

.4 Acoustic Core: Manufacturer's proprietary standard composite core, tested as part of a fully operable assembly in accordance with ASTM E90 and ASTM E413 to provide Sound Transmission Class indicated.

.5 Acoustic Glass: Clear, acoustic level conforming to that of the door/frame unit.

.6 Acoustic Gaskets: Manufacturer's proprietary standard, tested as part of fully operable assembly in accordance with ASTM E90 and ASTM E413 to provide Sound Transmission Class indicated.

.7 Adhesives for Honeycomb Cores and Steel Components: Heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.8 Galvanizing Touch Up Paint: High zinc dust content, Zinc Clad 5 by Sherwin Williams.

.9 Door Silencers: Single stud rubber/neoprene type

.10 Welding: CSA W59-M.

.11 Filler: Metallic paste, manufacturer's standard.

.12 Thermal Break: Rigid polyvinylchloride extrusion.

.13 Foam Insulation: Refer to Section 07 21 00 Thermal Insulation for requirements.

2.2 FABRICATION - GENERAL

.1 Blank, reinforce, drill and tap units for mortised, templated hardware, and electronic hardware using templates provided by the hardware suppliers. Reinforce units for surface mounted hardware.

.2 Do welding to CSA W59.

.3 Factory apply touch up primer to doors and frames manufactured from metallic coated steel where coating has been removed during fabrication.

.4 Provide appropriate anchorage to floor and wall construction.

.5 Make provisions in doors and frames to suit requirements of Section providing security devices.

.6 Fabricate fire protection rated assemblies to ULC requirements and bearing ULC, cUL or Warnock-Hersey International Ltd., label, as acceptable to authorities having jurisdiction.

.7 Locate fire protection rating labels on the inside of the frame hinge jamb and door hinge edge midway between the top hinge and the head of the door.

2.3 FABRICATION – FRAMES AND SCREENS

.1 Fabricate frames to profiles and maximum face sizes as required to suit design, welded construction.

.2 Cut mitres and joints accurately and weld continuously on inside of frame profile.

.3 Grind welded corners and joints to flat plane, fill with metallic paste filler and sand to uniform smooth finish.

.4 Protect mortised cutouts with mortar guard boxes in masonry and concrete constructions. Conceal fastenings except where exposed fastenings are required.

.5 Fabricate metal screens to profiles required. Supply jamb and mullion extensions and anchors required to secure screens to the structure or framing provided under other construction. Fabricate anchorage to prevent transfer of load from support framing to the screens when deflection of structure occurs. Provide concealed reinforcement for screens to receive handrails. Provide closely fitted steel glass stops where required. Mitre corners. Drill and countersink fasteners symmetrically at min 150 mm (6") o.c. Screw stops in place.

.6 Provide jamb anchors for fixing at floor.

.7 Provide three door silencers on strike jamb for each single door, and two bumpers at head of frame for each door leaf in double doors.

.8 Fabricate thermally broken frames for exterior doors, separating exterior portion of frame from interior portion with polyvinyl chloride thermal breaks.

.9 Reinforce strike and hinge jambs with crimped 100 mm x 1.519 mm thick (4" x 0.060" thick) steel reinforcement spot welded to jamb returns at locations corresponding to hinge heights. Weld reinforcement to inside of jambs. Set reinforcement flush with outside of jambs.

2.4 FABRICATION – DOORS AND PANELS

.1 General: Fabricate swing type doors, flush, with provision for glass and/or louvre openings as required.

.2 Fabricate work with longitudinal edges seamless, continuously welded, welds ground smooth, filled and sanded flush.

.3 Stainless Steel Doors: Longitudinal edges mechanically interlocked and adhesive reinforced.

.4 Stiffened Hollow Steel Construction, Exterior and Interior Assemblies: Form each face from single piece sheet steel. Reinforce doors with internal vertical stiffeners, securely laminated or welded to each face sheet at 150 mm (6") on centre maximum. Fill voids between stiffeners of exterior assemblies with fibreglass insulation core.

.5 Stiffened Hollow Steel Construction: Form each face from single piece sheet steel. Reinforce doors with internal vertical stiffeners, securely laminated or welded to each face sheet at 150 mm (6") on centre maximum.

.1 Exterior Assemblies: Fill voids between stiffeners with insulation core.

.2 Interior Assemblies, TRR Rated: Fill voids between stiffeners temperature rise rated core.

.6 Fabricate work with top and bottom full width steel channels, continuously welded, welds ground smooth, filled and sanded flush. Provide flush steel top edge on exterior assemblies.

2.5 FABRICATION – GLAZING STOPS

.1 Fixed Glazing Stops: Formed integral with door faces and frames, minimum 16 mm (5/8") high, unless otherwise indicated.

.1 Locate fixed stops on outside of exterior and on secure side of interior doors and frames.

.2 Loose Glazing Stops: Formed channel, fabricated from same material as frames in which they are installed. Minimum 16 mm (5/8") high unless otherwise indicated.

.1 Locate loose stops on inside of doors and frames.

.3 Form corners of stops with butted or mitered hairline joints.

.4 Coordinate rabbet width between fixed and loose stops with type of glazing and type of installation indicated.

.5 Fasteners: Vandal resistant, countersunk flat or oval head machine screws spaced uniformly not more than 225 mm (9") o.c., and not more than 50 mm (2") from each corner.

2.6 FABRICATION - ACOUSTIC DOORS AND FRAMES

.1 Manufacturer's proprietary standard, tested as part of a fully operable assembly in conformance with ASTM E90 and ASTM E413 to provide Sound Transmission Class indicated.

.2 Prepare and supply frames with manufacturer's proprietary design of frame gasketing system.

.3 Factory install acoustic glass in accurately fitted glazing stops.

3 Execution

3.1 INSTALLATION - GENERAL

.1 Install fire protection rated assemblies in accordance with NFPA 80.

.2 Touch up galvanized finish damaged during installation with galvanizing paint.

3.2 INSTALLATION - FRAMES

.1 Set frames plumb, square, level and at correct elevation.

.2 Provide suitable anchors to suit construction. Use one base anchor and two wall anchors per jamb side for frames up to 1500 mm (60") and one additional wall anchor per jamb side for each additional height of 750 mm (30") or fraction thereof.

.1 In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

.3 Secure anchorages and connections to adjacent construction.

.4 Brace frames rigidly in position while building in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Remove temporary spreaders after frames are built in.

.5 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.6 Exterior Frames: Completely fill frame space with foam-in-place insulation.

3.3 INSTALLATION - DOORS

.1 Provide even clearance, measured from the pull face of doors:

.1 Between Top and Vertical Edges of Door and Frames: 3 mm plus/minus 1.6 mm (1/8" plus/minus 1/16”).

.2 Between Meeting Edge of Doors Swinging in Pairs: 3 mm plus/minus 1.6 mm (1/8" plus/minus 1/16”)

.3 Between Door Bottom to Finished Floor, Non-Rated Assemblies: 12 mm (1/2"), unless otherwise indicated.

.4 Between Door Bottom ot Finished Floor, Fire Protection Rated Assemblies: To NFPA 80 requirements.

.5 Between Door Bottom to Thresholds: 6 mm (1/4”).

.6 Adjust operable parts for correct function.

3.4 CLEANING

.1 Clean and make good all surfaces soiled or otherwise damaged in connection with work. Upon completion of work and remove debris, equipment and excess material from site.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of prefabricated fire rated and non fire rated wall and floor access doors and panels.

1.3 SUBMITTALS

.1 Shop Drawings: Indicate each type of access doors, arrangement of hardware, operating mechanism and required clearances.

.2 Maintenance Data: Provide operation and maintenance data for incorporation into Maintenance Manual.

2 Products

2.1 MATERIALS

.1 Aluminium Plates: 6061-T6 alloy, anodizing quality.

.2 Aluminium Extrusions: 6063 alloy, T5 temper, anodizing quality.

.3 Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 304 or 316; with minimum sheet thickness indicated representing specified thickness in accordance with ASTM A480/A480M.

.4 Fasteners: Manufacturer's standard to suit intended use, non-corrosive and compatible with in-contact metals.

.5 Grout: Nonshrink, nonmetallic, flowable, 24h, 15 MPa (2100 psi), pullout strength 7.9 MPa (1150 psi).

2.2 WALL ACCESS DOORS

.1 Flush, Insulated, Water Resistant Wall Access Doors and Frames with Exposed Trim.

.1 Door: Flush panel with a core of manufacturer's standard insulation enclosed in minimum 1.6 mm thick stainless steel sheet metal.

.2 Frame: Minimum 1.6 mm thick stainless steel sheet metal with 25 mm wide, surface mounted trim.

.3 Gaskets: Continuous neoprene gaskets.

.4 Hinges: Concealed pin type.

.5 Automatic Closer: Spring type.

.6 Lock: Manufacturer's standard key operated lock with interior release.

.7 Stainless Steel Finish: No. 4 finish.

.2 Flush, Uninsulated, Fire Rated, Wall Access Doors and Frames with Exposed Trim.

.1 Door: Minimum 1.5 mm thick stainless steel sheet metal, flush construction.

.2 Frame: Minimum 1.5 mm thick stainless steel sheet metal with 25 mm wide, surface mounted trim.

.3 Hinges: Concealed pin type.

.4 Automatic Closer: Spring type.

.5 Lock: Manufacturer's standard key operated lock with interior release.

.6 Stainless Steel Finish: No. 4 finish.

2.3 FLOOR DOORS

.1 Specified Product: Flush mount, aluminium, capable to support 1464 kg/sq.m. (300 psf) live load, drainable, all stainless steel hardware, odour resistant.

.1 Single Leaf: J-AL-R Series by The Bilco Company.

.2 Double Leaf: JD-AL-R Series by The Bilco Company.

.2 Specified Product: Flush mount, stainless steel, capable to support 1464 kg/sq.m. (300 psf) live load, drainable, all stainless steel hardware, odour resistant.

.1 Single Leaf: J-SS-R Series by The Bilco Company.

.2 Double Leaf: JD-SS-R Series by The Bilco Company.

.3 Cover and Frame: Mill finished, diamond pattern reinforced aluminium cover plate, 6 mm (1/4") thick exclusive of raised pattern, and 6 mm (1/4") extruded aluminium channel frame with bend down anchor tabs and continuous EPDM perimeter gasket.

.4 Lifting Mechanisms: Compression spring operators, controlling cover operation throughout the entire arc of cover upward motion and acting as a check in retarding cover downward motion when closing.

.5 Turn and Lift Handle: Removable exterior turn/lift handle with a spring loaded ball detent and protected by a flush, gasketted, removable screw plug.

.6 Hinges: Heavy stainless steel duty hinges, each having a minimum 6.3 mm (1/4") diameter Type 316 stainless steel pin, maintain cover does not protrude into the channel frame.

.7 Hold Open Arm: Equip cover with an hold open arm which automatically locks the cover in the open position.

.8 Locks: Snap lock with fixed handle mounted on the underside of the cover.

2.4 REMOVABLE FLOOR COVERS

.1 Specified Product: Flush mount, capable to support 732 kg/sq.m. (150 psf) live load, Type FD8060 by Acudor Products Inc.

.2 Cover and Frame: Mill finished, diamond pattern refinished aluminium cover plate, 6 mm (1/4") thick exclusive of raised pattern, and 6 mm (1/4") extruded aluminium angle frame with bend down anchor tabs and continuous EPDM perimeter gasket.

2.5 FIRE RATED FLOOR DOORS

.1 Specified Product: Flush mount, capable to support 732 kg/sq.m. (150 psf) live load, labelled and listed by an organization acceptable to authority having jurisdiction for required fire protection rating, Type FR by The Bilco Company.

.2 Cover and Frame: 25 mm (1") recess reinforced fillable pan to receive concrete or a combination of concrete and floor finish, and 6 mm (1/4") extruded aluminium channel frame with bend down anchor tabs, continuous perimeter gasket and coated with intumescent fire resistant material.

.3 Lifting Mechanism: Compression spring operators enclosed in telescopic nylon reinforced composite tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. Spring in electro coated acrylic finish.

.4 Automatic Closing System: Self contained, pneumatic, fusible link activated, closing system that will automatically close and latch the door in the event of fire.

.5 Hold Open System: Pneumatic hold-open system to automatically hold the door in the 90 degree open position. Provide release button for the hold-open system and for resetting itself when the cover is closed.

.6 Hinges: Continuous heavy duty Type 316 stainless steel hinge accessible only when the cover is in the open position.

.7 Turn and Lift Handle: Removable exterior turn/lift handle with a spring loaded ball detent and protected by a flush, gasketted, removable screw plug.

.8 Lock: Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover and a cable release handle shall be provided to open the cover from the underside.

2.6 FLOODTIGHT FLOOR DOORS

.1 Specified Product: Flush mount, capable to support AASHTO H-20 loading, and watertight under a 7.62 m (25') water pressure acting on the top side, all stainless steel hardware, Type WT by The Bilco Company.

.2 Cover and Frame: Mill finished, diamond pattern reinforced aluminium cover plate, 6 mm (1/4") thick exclusive of raised pattern, and 6 mm (1/4") extruded aluminium channel frame with bend down anchor tabs and continuous 20 durometer neoprene perimeter gasket.

.3 Lifting Mechanisms: Compression spring operators, controlling cover operation throughout the entire arc of cover upward motion and acting as a check in retarding cover downward motion when closing.

.4 Turn and Lift Handle: Compression latch with removable exterior turn/lift handle in a bronze threaded cover with key wrench.

.5 Hinges: Heavy duty stainless steel hinges with stainless steel pin.

.6 Hold Open Arm: Equip cover with an hold open arm which automatically locks the cover in the open position.

.7 Locks: Type 316 stainless steel snap lock with fixed handle mounted on the underside of the cover.

3 Execution

3.1 EXAMINATION

.1 Verify dimensions and conditions of previously installed work, upon which this Section depends, and coordinate repairs, alterations, and rectification if necessary.

.2 Obtain Contract Administrator's written approval prior to field cutting or altering of structural members.

3.2 INSTALLATION

.1 Install work level, true, square, straight, and accurate to sizes detailed, free from distortion or defects detrimental to appearance or performance.

.2 Perform drilling of concrete as required to fasten work of this Section.

.3 Grout work in concrete with non-shrink grout. Trowel surface smooth and flush with adjacent surfaces.

.4 Insulate metals where necessary to prevent corrosion due to contact between dissimilar metals and between metals and concrete. Use bituminous paint, butyl tape, building paper or other approved means.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of the following types of electric motor operated overhead coiling doors:

.1 Insulated Service Doors

.2 Non-Insulated Service Doors

.3 Fire Rated Service Doors, ULC labelled fire doors to rating as indicated in the drawing..

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 SYSTEM DESCRIPTION

.1 Wind Loads: Completed work shall withstand positive and negative wind pressure loads normal to plane required by the governing building code.

.2 Construct fire rated doors in accordance with the testing agency, Underwriters' Laboratories, Inc. Bear ULC or cUL rating label for the fire rating classification as indicated in the Contract Drawing.

1.5 SUBMITTALS

.1 Product Data: Submit product data for each type and size of overhead coiling door and accessories.

.2 Shop Drawings:

.1 Submit shop and erection drawings in accordance with General Conditions.

.2 Show and describe with dimensions in detail special door assemblies, including elevations, sections and detail of doors, hardware and operating components, and of relationship of door to adjacent construction including dimensions, gauges, thickness, description of materials, finishes, as well as all other pertinent data and information.

.3 Samples: Submit manufacturer's colour charts showing full range of colours available for units with factory applied finishes for initial selection.

.4 Certificates: Submit certification for oversize door assemblies having fire ratings that exceed size limitations of labelled assemblies.

.5 Maintenance Data and Operating Instructions: Upon completion of installation, supply copies of data all as per General Conditions.

.6 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentations to the following:

.1 Materials & Resources:

.1 MR Credit 4 - Recycled Content: 10% & 20% (post-consumer + ½ pre-consumer)

.2 MR Credit 5 - Regional Materials: 20% & 30% Extracted and Manufactured Regionally

.2 Indoor Environmental Quality

.1 IEQ Credit 4.1 - Low-Emitting Materials: Adhesives & Sealants

.2 IEQ Credit 4.2 - Low-Emitting Materials: Paints and Coating

1.6 QUALITY ASSURANCE

.1 Installer: Trained and approved by the manufacturer and having a minimum five years' experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.

.2 Maintenance Seminars: Engage a factory authorized service representative to train the City's maintenance personnel on proper maintenance procedures.

.3 Pre-Installation Meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.4 Manufacturer's Site Inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.5 Furnish each overhead coiling door as a complete unit produced by one manufacturer, including hardware, accessories, mounting and installation components. Furnish overhead coiling doors by one manufacturer for the entire project.

.6 Inserts and Anchorages: Furnish fasteners and spacers as required to facilitate installation. If special requirements are necessary, co-ordinate those requirements with the Contractor.

.7 Regulatory Agencies: Provide fire rated door with laboratory tested products acceptable to the Authority Having Jurisdiction for the following criteria:

.1 Fire and Smoke Rated: Provide fire rated doors and activation components meeting resistance ratings required for project; labelled and tested in accordance with NFPA 80 and ULC S104.

.2 Electrical: Provide electrical components, devices and accessories, motors, controls and wiring conforming to CSA Standards and CSA labelled.

1.7 SITE CONDITIONS

.1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where overhead coiling doors are required to fit within openings; coordinate fabrication schedule with construction progress to avoid delaying the Work.

.2 Established Dimensions: Establish dimensions and proceed with fabricating overhead coiling doors without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions.

1.8 ELECTRICAL CO-ORDINATION

.1 Electrical Requirements: Coordinate wiring requirements and power characteristics of work with building electrical system. Do wiring in strict conformity with requirements of the Electrical Code and Electrical Sections.

.1 Work by Electrical Sections: Supply and installation of disconnect switch/junction box and power to the disconnect switch/junction box.

.2 Work by This Section: Wiring and connection at and from disconnect switch/junction box to motors, starters, switches, controls, safety devices and other items requiring power.

.3 Coordinate and confirm building power as per electrical drawings and specifications.

.2 Employ licensed electrician to wire and interconnect all operational and safety components for the Work. Terminate wiring required for connection to control circuitry and power at NEMA enclosures. Ground all control wiring.

.3 Electrical Components, Devices, and Accessories: CSA certified and labelled.

1.9 WARRANTY

.1 Warrant work of this section against defects in materials and workmanship in accordance with General Conditions but for three (3) years. Agree to make good promptly any defects which occur within this period.

2 Products

2.1 MANUFACTURER

.1 Specified Products: Product specified is product by the manufacturers specified. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

.1 Type 1: Non-insulated, ESD10 by Cornell Iron Works Doors.

.2 Type 2: Insulated, ESD20 by Cornell Iron Works Doors.

.3 Type 3: Non-insulated fire rated, ERD10 by Cornell Iron Works Doors.

.4 Type 4: Non-insulated, counter door ESC10 by Cornell Iron Works Doors.

2.2 MATERIALS

.1 Galvanized Steel Sheet: Commercial quality to ASTM A653, Z275 coating designation.

.2 Steel Shapes, Plates, and Similar Items: CAN/CSA-G40.20-G40.21-M, Grade 350W, hot dipped galvanized to CSA G164.

.3 Aluminium Sheet Metal: Plain finish utility sheet.

.4 Aluminium Extrusions: Aluminium Association alloy AA6063-T5.

.5 Stainless Steel Sheet Metal: ASTM A167, Type 304 with brushed finish.

.6 Galvanizing Touch Up Paint: High zinc dust content, Zinc Clad 5 by Sherwin Williams.

.7 Insulation: Manufacturer's standard rigid cellular polystyrene or polyurethane-foam-type thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ULC S102.

.8 Smoke Seals: Provide UL-listed and -tested smoke-seal perimeter gaskets.

.9 Weatherseals: Provide replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to jambs, bottom and top of exterior doors. At door head, use 3 mm (1/8") thick, replaceable, continuous sheet secured to inside of hood.

.1 Motor Operated Doors: Combination bottom weatherseal and sensor edge.

2.3 FABRICATION

.1 Fabricate fire rated rolling metal coiling doors to NFPA 80.

.2 Door Curtains: Fabricate overhead coiling door curtain of 75 mm (3") interlocking galvanized sheet steel slats factory finished in baked enamel coating, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated. Provide insulated doors as indicated.

.1 Type 1: Non-insulated doors, minimum 0.8 mm (20 gauge) steel sheet.

.2 Type 2: Insulated doors, overall 23 mm (0.9") thick slats consists 1.0 mm (18 gauge) exterior steel sheet, 0.5 mm (24 gauge) interior steel sheet and cavity filled with foam in place-in-place closed cell urethane insulation, enclose insulation completely within metal slat faces.

.3 Type 3: Fire rated doors, minimum 1.0 mm (18 gauge) steel sheet.

.4 Type 4: Non-insulated counter doors, minimum 0.65 mm (22 gauge) steel sheet.

.3 Curtain Jamb Guides: Steel angles or channels and angles, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Build up units with not less than 5 mm (3/16") thick galvanized steel. Slot bolt holes for guide adjustment.

.1 Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

.4 Counterbalance Assembly: Rated for 100,000 door open-close cycles, consisting of torsion spring with 25% overload factor. Enclose spring in steel pipe to support door curtain and counterbalance mechanism with maximum deflection of 1/360th of opening width. Provide ball bearings at rotating points. Provide spring tension adjusting wheel, accessible for setting.

.1 Push-Up Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 25 lbf (111 N).

.2 Support counterbalance assembly on 5 mm minimum thickness steel plate brackets, forming end enclosures.

.5 Hood: Same material as doors, form to act as weatherseal and entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and provide fascia for any portion of between jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sagging.

.1 Fire Rated Assemblies: Automatic drop baffle to guard against passage of smoke or flame.

.6 Endlocks and windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

.7 Endlocks for Counter Doors: Manufacturer's standard locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

.8 Bottom Bar for Service Doors: Consisting of 2 angles, each not less than 38 mm x 38 mm x 3 mm (1-1/2" x 1-1/2" x 1/8"), same material and finish as curtain slats.

.9 Bottom Bar for Counter Doors: Manufacturer's standard continuous channel or tubular shape, same material and finish as curtain slats.

.10 Push/Pull Handles: For push up operated or push up emergency operated doors, provide stainless steel lifting handles on each side of door.

.1 Provide pull-down straps or pole hooks for doors more than 2100 mm (7') high.

.11 Equip doors for locking from inside with cylinder locks compatible with master keying system for cylinder as specified in Division 8 Section Finish Hardware.

.12 Fire Rated Assemblies:

.1 Provide fusible link activate automatic closing device to close door at controlled slow even speed upon activation.

.2 Provide automatic closing device connected to heat and smoke detection equipment.

.3 Arrange automatic closing device to permit manual lifting of curtain for emergency exit after automatic closing with doors returning to closed position when released.

.4 Capable of resetting and testing by user.

2.4 ELECTRIC DOOR OPERATORS

.1 General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

.2 Electric Motors: High starting torque, reversible, continuous-duty, worm gear, heavy duty industrial type, bracket mounted, Class A insulated, with overload protection; sized to start, accelerate, and operate door in either direction from any position, at not less than 0.2 m/s (2/3 f/s) and not more than 0.3 m/s (1 f/s).

.1 Coordinate wiring requirements and electrical characteristics of motors with building electrical system.

.3 Back Up Manual Operation: Chain hoist equipped with a disconnect device which allows the operator to be disengaged from the door and operate the door manually from the floor by hand in the event of a power failure without having to remove the drive roller chain.

.4 Electric interlock switch which will automatically cut off power of operator when hydraulic dock leveller is in operation, to prevent door closing on raised dock leveller or to prevent dock leveller raising on closed door.

.5 Brake: Solenoid disc brake to prevent door from coasting and secure stopping and locking of door in any position.

.6 Control Station: 3-button control, momentary contact type, open-close-stop, mounted on wall adjacent to door in location where directed by Contract Administrator.

.7 Sensor Edge: Provide each motorized door with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward door travel. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

.1 Provide electrically actuated automatic bottom bar.

.8 Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

2.5 STEEL AND GALVANIZED STEEL FINISHES

.1 Baked Enamel Coating: Manufacturer's standard finish consisting of primer and topcoat in accordance with coating manufacturer's written instructions for cleaning, pretreatment, application, thermosetting, and minimum dry film thickness.

.1 Colour: White from manufacturer’s standard colour chart.

3 Execution

3.1 EXAMINATION

.1 Examine areas of work that affect the work of this section. Report in writing all errors, defects and discrepancies immediately to the Contract Administrator.

.2 Commencement of work implies acceptance of surfaces and conditions.

3.2 INSTALLATION

.1 Install work in accordance with manufacturers' printed instructions.

.2 Touch up galvanized finish damaged during installation with galvanizing paint.

.3 Adjust operable parts for correct function and smooth operation.

.4 Test labelled doors in the presence of the City for proper operation by activating fusible link.

.5 Replace damage work with new work in matching finish and colour.

3.3 ADJUSTMENT AND CLEANING

.1 Adjust work to ensure free-running, tightly closing and properly counterbalanced operation. Ensure that installation is free from warp, twist or other distortion. Lubricate operating hardware only as recommended by the manufacturer.

.2 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at site only if approved by the Contract Administrator.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of the electric motor operated high speed rapid rolling doors.

1.3 REFERENCE DOCUMENTS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 Applicable standards; standards of the following, as referenced herein:

.1 American Society for Testing and Materials (ASTM).

.2 National Electrical Manufacturer's Association (NEMA).

.3 Underwriters laboratories, Inc. (UL).

.4 Canadian Standards Association (CSA).

1.4 DESIGN REQUIREMENTS

.1 Wind Loading:

.1 Design high speed rapid rolling doors to withstand a wind load condition of 20 lbs./sq.ft. positive wind load pressure, or equivalent 140 Kph wind load pressure.

1.5 SUBMITTALS

.1 Product Data: Submit product data for each type and size of high speed rapid rolling door and accessories.

.2 Shop Drawings:

.1 Submit shop and erection drawings in accordance with General Conditions.

.2 Show and describe with dimensions in detail special door assemblies, including elevations, sections and detail of doors, hardware and operating components, and of relationship of door to adjacent construction including dimensions, gauges, thickness, description of materials, finishes, as well as all other pertinent data and information.

.3 Samples: Submit manufacturer's colour charts showing full range of colours available for units with factory applied finishes for initial selection.

.4 Maintenance Data:

.1 Provide three copies of instructions covering operation, adjustments and relevant maintenance data for incorporation into Operation and Maintenance Manual.

.5 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentations to the following:

.1 Materials & Resources:

.1 MR Credit 4 - Recycled Content: 10% & 20% (post-consumer + ½ pre-consumer)

.2 MR Credit 5 - Regional Materials: 20% & 30% Extracted and Manufactured Regionally

.2 Indoor Environmental Quality

.1 IEQ Credit 4.1 - Low-Emitting Materials: Adhesives & Sealants

.2 IEQ Credit 4.2 - Low-Emitting Materials: Paints and Coating

1.6 QUALITY ASSURANCE

.1 Installer: Trained and approved by the manufacturer and having a minimum five years' experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.

.2 Maintenance Seminars: Engage a factory authorized service representative to train the City's maintenance personnel on proper maintenance procedures.

.3 Pre-Installation Meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.4 Manufacturer's Site Inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.5 Furnish each high speed rapid rolling door as a complete unit produced by one manufacturer, including hardware, accessories, mounting and installation components. Furnish high speed rolling doors by one manufacturer for the entire project.

.6 Inserts and Anchorages: Furnish fasteners and spacers as required to facilitate installation. If special requirements are necessary, co-ordinate those requirements with the Contractor.

1.7 SITE CONDITIONS

.1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where high speed rapid rolling doors are required to fit within openings; coordinate fabrication schedule with construction progress to avoid delaying the Work.

.2 Established Dimensions: Establish dimensions and proceed with fabricating high speed rapid rolling doors without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions.

1.8 ELECTRICAL CO-ORDINATION

.1 Electrical Requirements: Coordinate wiring requirements and power characteristics of work with building electrical system. Do wiring in strict conformity with requirements of the Electrical Code and Electrical Sections.

.1 Work by Electrical Sections: Supply and installation of disconnect switch/junction box and power to the disconnect switch/junction box.

.2 Work by This Section: Wiring and connection at and from disconnect switch/junction box to motors, starters, switches, controls, safety devices and other items requiring power.

.3 Coordinate and confirm building power as per electrical drawings and specifications.

.2 Employ licensed electrician to wire and interconnect all operational and safety components for the Work. Terminate wiring required for connection to control circuitry and power at NEMA enclosures. Ground all control wiring.

.3 Electrical Components, Devices, and Accessories: CSA certified and labelled.

1.9 WARRANTY

.1 Five (5) years limited warranty on mechanical components, including motor assembly.

.2 Two (2) years limited warranty on electrical components.

.3 Two (2) years limited warranty on standard door panels, rollers, hinges and door tracks.

2 Products

2.1 MANUFACTURER

.1 Specified Products: Work of this Section is based on products Spiral High Performance Doors by Rytec Corporation. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator‘s acceptance.

2.2 MATERIALS

.1 Door Panel: Overall 150 mm (6”) high by 30 mm (1-3/16”) thick slats, with integral rubber weatherseal between each slat.

.1 Slats:

.1 Solid Slats: Consists of two of aluminum sheets with insulated infill.

.2 Vision Slats: Full width aluminium framed with Lexan clear polycarbonate panel infill.

.2 Connect slats with hinges for rigidity and security.

.2 Side Frames: 2.05 mm (12 gauge) galvannealed steel, powder coat finish.

.1 Support weight of single element top roll to form self supporting system when assembled.

.2 Provide built-in windbar channel for front and rear windbar operation.

.3 Provide EPDM rubber seals on both sides of door panel on each side frame to seal against door panel.

.4 Pre-drill side frames for anchor devices.

.3 Bottom Bar: Extruded aluminum bottom bar

.1 Equip electric reversing edge for door able to reverse to open when contacting an object.

.4 Counterbalance:

.1 Maximum six extension springs in each side column to assist motor to open door.

.2 Equip with mechanical release lever on side column to open door when power failure.

.5 Drive system:

.1 Minimum 2 HP motor with variable speed AC drive.

.2 Allow soft acceleration and braking

.6 Travel Speed:

.1 Open: 60 inches per second.

.2 Close: 24 inches per second.

.7 Electrical Controls: Rytec Controller.

.1 House controller in UL/cUL listed NEMA 4X-rated enclosure.

.1 Allow parameter and configuration change for door can made from the face of the control box, no exposure to high voltage.

.2 Include control with variable speed AC drive system for speed control in both directions.

.3 Programmable inputs and outputs accommodate special control applications includes, but not limited to the following:

.1 Traffic lights.

.2 Horns.

.3 Actuation devices.

.4 Timing sequences.

.4 Two lines vacuum fluorescent display, with self-diagnostic informational messages for straightforward installation, control adjustments and error reporting.

.8 Use encoder to regulate door travel limits.

.1 Adjust travel limits at control panel without use of tools.

.9 Door Track: Spiral rollup without metal-to-metal contact, ultra-quiet, low maintenance operation and eliminates wear on panel slats.

.10 Windload: Capable of withstanding winds up to 127 mph (20 psf).

2.3 SAFETY SYSTEMS

.1 Include Rytec SmartSurround® Advanced Detection and Alert system consisting of:

.1 Two sets of high density LED light with 180 degree and range of 30’ visibility for alert and awareness on both sides of door opening:

.1 Light activate when obstruction present in doorway.

.2 Equip exterior units with stainless steel cable jacketing for protection to IP67 rating (dust/waterproof)

.3 CAN Bus communication and connection technology provide connection via quick-connect cables allows for extensive data and integration between SmartSurround system and System 4 door controller.

.4 Integrate SmartSurround and System 4 controller software to allow specific actions to obstructions, normal and abnormal traffic.

3 Execution

3.1 INSTALLATION

.1 Install work in accordance with manufacturers' printed instructions.

.2 Connect and adjust electrical components and operating hardware.

.3 Touch-up paint on frame and other painted surfaces in accord with painting section.

.4 Upon completion of installation, including work by other trades, lubricate, test and adjust doors to operate in accordance with manufacturer's product data. Final adjustments shall be made by manufacturer's authorized representative.

.5 Protect finished installations until date of Substantial Performance. Repair damage to door panel, hardware and operators.

.6 Test doors in the presence of the City for proper operation by activating fusible link.

.7 Replace damage work with new work in matching finish and colour.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of insulated sectional overhead doors with electric motor operated.

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 QUALITY ASSURANCE

.1 Installer: Trained and approved by the manufacturer and having a minimum three years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.

.2 Maintenance Seminars: Provide, to the City, training seminars and recommendations on Product maintenance procedures.

.3 Pre-Installation Meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.4 Manufacturer’s Site Inspection: Have the manufacturer’s technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer’s inspection reports and verification that the work of this Section is correctly installed.

.5 Source Limitations: Obtain each type of product from a single manufacturer.

1.5 DESIGN REQUIREMENTS

.1 Design exterior door assembly to withstand a minimum windload as required by the building code for maximum horizontal deflection of 1/240 of opening width.

1.6 SUBMITTALS

.1 Shop Drawings:

.1 Submit detailed shop drawing showing fabrication and installation requirements. Show thicknesses of metal, insulation, construction details, operating mechanisms required clearances and electrical connections.

.2 Operating and Maintenance Data:

.1 Provide operating and maintenance data for incorporation into the Operating and Maintenance Manual.

.3 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentations to the following:

.1 Materials & Resources:

.1 MR Credit 4 - Recycled Content: 10% & 20% (post-consumer + ½ pre-consumer)

.2 MR Credit 5 - Regional Materials: 20% & 30% Extracted and Manufactured Regionally

.2 Indoor Environmental Quality

.1 IEQ Credit 4.1 - Low-Emitting Materials: Adhesives & Sealants

.2 IEQ Credit 4.2 - Low-Emitting Materials: Paints and Coating

1.7 STORAGE, DELIVER, HANDLING AND PROTECTION

.1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.2 Handle products with care. Do not slide panels over rough surfaces or each other.

.3 Keep panels covered and dry while in transit, storage and at work sites.

1.8 ELECTRICAL CO-ORDINATION

.1 Electrical Requirements: Coordinate wiring requirements and power characteristics of work with building electrical system. Do wiring in strict conformity with requirements of the Electrical Code and Electrical Sections.

.1 Work by Electrical Sections: Supply and installation of disconnect switch/junction box and power to the disconnect switch/junction box.

.2 Work by This Section: Wiring and connection at and from disconnect switch/junction box to motors, starters, switches, controls, safety devices and other items requiring power.

.3 Coordinate and confirm building power as per electrical drawings and specifications.

.2 Employ licensed electrician to wire and interconnect all operational and safety components for the Work. Terminate wiring required for connection to control circuitry and power at NEMA enclosures. Ground all control wiring.

.3 Electrical Components, Devices, and Accessories: CSA certified and labelled.

1.9 WARRANTY

.1 Warrant work of this section against defects in materials and workmanship in accordance with General Conditions but for three (3) years. Agree to make good promptly any defects which occur within this period.

.2 Warrant door sections against defects in material and workmanship, and deterioration due to rust-through for ten (10) years from date of delivery to the original purchaser.

.3 Warrant the door sections against delamination of the polyurethane foam insulation from the steel skins for ten (10) years from date of delivery to the original purchaser.

.4 Warrant window components against defects in material and workmanship for five (5) year from date of delivery to the original purchaser.

2 Products

2.1 MANUFACTURERS

.1 Specified Products: Product specified is product Thermatite 175 by Richard Wilcox Door Systems. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator’s acceptance.

.2 Other acceptable manufacturers:

.1 Steel-Craft Door Products Ltd.

.2 Upwardor Corporation.

2.2 MATERIALS

.1 Steel: CAN/CSA G40.20-M and CAN/CSA G40.21-M, Grades 350W, hot dipped galvanized to CSA G164.

.2 Galvanized Steel Sheet (Commercial Quality): Galvanizing as specified ASTM A653M, plain commercial galvanized stretcher levelled or temper rolled. Where steel is exposed and finish painted specially treated by a phosphate conversion process or similar pre paint process.

.3 Extruded Aluminium Shapes: ASTM B221, alloy and temper recommended by aluminium producer and finisher for type of use and finish indicated.

.4 Sheet Aluminium: ASTM B209, alloy and temper recommended by aluminium producer and finisher for type of use and finish indicated.

.5 Insulation: High pressure, CFC-free, fire retardant polyurethane even textured closed cell, manufacturer's standard.

.6 Glass and Glazing:

.1 Insulated Glass Unit: Two panes 6 mm (1/4") thick tempered glass panels to CAN/CGSB 12.1, Type 2, Class B with 13 mm (1/2") sealed air space.

2.3 STEEL DOOR PANEL SECTIONS

.1 Steel Door Panels: 50 mm (2") thick, polyurethane core injected and foamed in place between exterior and interior steel skins fabricated from roll formed galvanized steel sheets; provide thermal break at horizontal joints between panels; equip panels with galvanized steel end caps 1.6 mm (16 gauge) thick, reinforced to receive hardware.

.1 Continuously weld joints full length to suit requirements.

.2 Finish:

.1 Treat panels properly and shop apply urethane finish. Apply finish in accordance with coating manufacturer's written instructions for application, thermosetting, and minimum dry film thickness. Standard colour white.

2.4 TRACK, HARDWARE AND ACCESSORIES

.1 Track: 75 mm (3") wide, 11 gauge formed steel, hot dipped galvanized to ASTM A653M Z275 coating designation. Slope vertical tracks for weathertight closing. Make curves of proper radius for quiet and free action and mount to full size gusset plates. Horizontal and vertical track shall join curve on gusset plate; reinforce horizontal tracks full length with steel angles to prevent deflection. Mount vertical tracks to door jambs using continuous full length track mounting angles to prevent movement in vertical tracks. Size and thickness of steel angles to suit door opening and as recommended by manufacturer.

.2 Track Hangers: Provide galvanized and prime painted steel angles of sufficient number to properly hang hardware. Galvanize to zinc coating designation Z275.

.3 Rollers: 75 mm (3") diameter, 15 mm (5/8") diameter ball bearings, 11 mm (7/16") diameter roller axles, hardened steel wheels.

.4 Roller Brackets: Hinged and fabricated from 3 mm (1/8") minimum overall thickness, zinc coating designation Z275, 11 gsg galvanized steel. Fit brackets with heavy duty steel tube cross pieces in which roller axles shall ride. Reinforce brackets with steel gusset plates.

.5 Bottom Roller Brackets: Wrap around design, picking up bottom corner of door and acting as bottom roller carrier. Fit brackets with a pick up cable anchoring device.

.6 Head Shaft: 25 mm to 32 mm (1" or 1-1/4") diameter solid steel shafting. Run shaft in ball bearings located at both gusset plates as well as at intermediate shaft brackets across head of shaft as required for proper operation.

.7 Drums: Use proper size drums to suit both door height and weight. Height of door to determine amount of cable and weight of door to determine cable diameter. Cables shall be preformed galvanized aircraft type of 7 19 strands.

.8 Counter Balance: Helically wound, oil tempered, torsion springs custom engineered, designed and rated for 100,000 open and close cycles minimum, mounted on a continuous shaft revolving in anti friction bearings and having cable drum at each end.

.9 Door Latch: Heavy duty side latch operated from interior only as recommended by door manufacturer to suit door opening. Provide electrical interlock to electrically operated door to disconnect power.

.10 Adjustable Door Bottom Weather Stripping: EPDM rubber or neoprene bulb shaped astragal.

.11 Adjustable Jamb and Head Weather Stripping: Box typed clear anodized aluminium weatherstripping with replaceable arctic grade vinyl insert or manufacturer's standard for effective seal.

2.5 VISION PANELS

.1 Provide full section width vision panel insulated glass unit to locations in sectional overhead doors as indicated on drawings and schedules.

2.6 ELECTRIC DOOR OPERATOR

.1 Of suitable motor, designed by door manufacturer to operate doors of dimensions shown. Electrical motor and related components shall be supplied to suit voltage and other electrical characteristics of electrical system in building. 1/2 H.P., 208 volt, 3 phase, 60 Hz, complete with:

.1 Motor instantly reversible.

.2 Reversing, heavy duty, industrial type contactors with mechanical interlock.

.3 Solenoid operated brake.

.4 Quick release door arm.

.5 Pneumatic safety edge on bottom of door to reverse instantly on meeting an obstruction in downward travel.

.6 Take up reel for pneumatic safety edge.

.2 Back Up Manual Operation: Allow the operator to be disengaged from the door and operate the door manually from the floor by hand in the event of a power failure.

.1 Provide lift handles.

3 Execution

3.1 EXAMINATION

.1 Examine all areas of Work that affect the work of this section. Report in writing all errors, defects and discrepancies immediately to the Contract Administrator.

.2 Commencement of work of this section implies acceptance of surfaces and conditions.

3.2 INSTALLATION

.1 Reinforce horizontal tracks full length with steel angles to prevent deflection.

.2 Mount vertical tracks to support framing using continuous full length track mounting angles to prevent movement in vertical tracks. Size and thickness of steel angles to suit door opening and as recommended by manufacturer.

.3 Slope vertical tracks for weathertight closing. Make curves of proper radius for quiet and free action and mount to full size gusset plates.

.4 Install doors to fit snugly to edges of jambs and heads of frames. Adjust doors to operate smoothly and freely under conditions of operation. Tension of springs shall hold door in open position without drifting downward or upward.

.5 Fit weather stripping snugly to doors so there is no rubbing action of weatherstripping until last moment contact. Make necessary adjustments until door is weathertight.

.6 Install hardware.

.7 Supply and install necessary appurtenances relating to door installation, required on door frames.

3.3 ADJUSTMENT AND DEMONSTRATION

.1 Upon completion of work of this section, and when directed by the Contract Administrator, adjust and lubricate sectional overhead doors, check and adjust controls, ensure that all equipment and mechanisms are operating smoothly, and demonstrate the operation, control and safety features of each door to the Contract Administrator and the City.

3.4 CLEANING AND CLEAN-UP

.1 Clean and make good to the Contract Administrator's approval, surfaces soiled or otherwise damaged in connection with the work of this section. Contractor shall pay the cost of replacing finishes or materials that cannot be satisfactorily cleaned.

.2 On completion of the work of this section, remove all debris, equipment and excess material from the site that results from the work of this section.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this section.

1.2 SUMMARY

.1 This Section includes requirements for design, supply and installation of glazed curtain wall system and other accessories as required to complete the Work of this contract.

1.3 RELATED REQUIREMENTS

.1 Coordinate with Work of other Sections having a direct bearing on Work of this Section.

1.4 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A36/A36M, Specification for Carbon Structural Steel.

.2 ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.4 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.6 ASTM B22, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.7 ASTM E283, Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.8 ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls, by Uniform Static Air Pressure Difference.

.9 ASTM E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.

.10 ASTM E413, Classification for Rating Sound Insulation.

.11 ASTM E1105, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.

.3 American Architectural Manufacturers Association (AAMA):

.1 AAMA CW-10, Care and Handling of Architectural Aluminum From Shop to Site.

.2 AAMA CW-11, Design Wind Loads and Boundary Layer Wind Tunnel Testing.

.3 AAMA T1R-A1, Sound Control for Fenestration Products.

.4 AAMA 501, Methods of Test for Exterior Walls.

.5 AAMA 611, Voluntary Specifications for Anodized Finishes Architectural Aluminum.

.6 AAMA 612, Voluntary Specifications, Performance Requirements, and Test Procedures for Combined Coatings of Anode Oxide and Transparent Organic Coatings on Architectural Aluminum.

.7 AAMA 2603, Voluntary Specification Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.

.8 AAMA 2604, Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.

.4 Canadian Standards Association (CSA):

.1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members.

.3 CAN/CSA-S157/S157.1, Strength Design in Aluminum/Commentary on CAN/CSA-S157, Strength Design in Aluminum.

.4 CSA W59.2, Welded Aluminum Construction.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Meetings:

.1 Convene pre-installation meeting 2 week prior to beginning work of this Section.

.2 Require attendance of the Contract Administrator, Installer, Manufacturer, representatives of door systems to be installed in curtain wall system, and other parties directly affected by the work of this Section. Include inspection agency representative.

.3 Review:

.1 Curtain wall system drawings, specifications, and other contract documents affecting work.

.2 Submittals, completed and yet to be completed.

.3 Materials, shop and site fabrication, installation requirements, and structural silicone joints.

.4 Required inspections, operational testing, and certifying procedures.

.5 Construction schedule related to other work affecting curtain wall installation and verification of availability of materials, Installer's personnel, equipment, and facilities required to make progress and avoid delays.

.6 Preparation and installation procedures and coordination and scheduling required with related work.

.7 Weather and forecasted weather conditions and procedures for coping with unfavourable conditions.

.4 Tour, inspect, and discuss conditions, connections to building structure, and other preparatory work performed by other installers.

.5 Prepare and distribute minutes of meeting to the City and participating parties.

1.6 DESIGN AND PERFORMANCE REQUIREMENTS

.1 Design curtain wall system, including comprehensive engineering and thermal analysis by a qualified Engineer specialized in work of this section, using structural performance requirements and design criteria indicated herein.

.2 Compartmentalization seals to be air and water tight and capable of supporting design air pressure differences.

.3 System Design: Design and size components to withstand dead loads and live loads caused by positive and negative wind loads acting normal to plane of wall as calculated in accordance with applicable code, when tested in accordance with ASTM E330.

.4 Design structural steel used for anchorage in accordance with CA/CSA-S16.1.

.5 Design curtain wall anchors to accommodate thermal, seismic, and building movements without causing detrimental effect to system components and sealants, and to have a minimum expected service life of thirty years in accordance with CSA S478.

.6 Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable code.

.7 Effects of Combinations of Loads: Design system to withstand the most unfavourable combinations of loads.

.8 Deflection: Design structural performance of aluminum components of curtain wall in accordance with CSA S157/S157.1.

.1 Deflection Normal to Wall Plane: Limit mullion deflection to L/175 or 19mm whichever is less for spans less than 4270mm; L/240 + 6mm for spans higher than 4270mm, with full recovery of glazing materials.

.2 Deflection Parallel to Glazing Plane: L/360 of clear span or 3 mm, whichever is smaller.

.9 Deflection limits for sheet metal and air vapour barriers shall be L/360 of span or maximum 6mm whichever is less, under design loading.

.10 System Assembly: Accommodate without damage to system, components or deterioration of seals, movement within system, movement between system and perimeter framing components, dynamic loading and release of loads, deflection of structural support framing, tolerance of supporting components, column shortening, long-term creep of structural members, story drift, and deflection from uniformly distributed and concentrated live loads.

.11 Sound Transmission of Wall System (Exterior to Interior): Value as required by applicable code, when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E1332.

.12 Air Infiltration: Limit air infiltration through assembly to 0.00015 cu m/sq m of wall area, measured at a reference differential pressure across assembly of 300 Pa or 6.24 PFF as measured in accordance with ASTM E283.

.13 Water Leakage:

.1 Design system to provide resistance to water entry as evaluated by the following test procedures:

.1 Static Water Infiltration – No leakage at 720 Pa when tested to ASTM A331 or ASTM 1105

.2 Dynamic Water Infiltration – No leakage at 720 Pa when testing to AAMA 501.1

.14 Condensation Resistance: Prevent condensation and frost on inside surfaces of system when subject to outside temperature of minus 25 degrees C and 24 kph wind speed and inside temperature of 21 degrees C when interior relative humidity is 30 percent in a temperature index of 60 in accordance with CSA-A440-00.

.15 Expansion / Contraction: System to provide for expansion and contraction within system components caused by a cycling temperature range of 100 degrees C over a 12 hour period without causing detrimental effect to system components.

.16 Surface Temperature: System to be capable of withstanding metal surface temperature range of 110 degrees C without buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance. Design frames so that edges of inner pane of insulating glass units do not fall more than 8 degrees C below the temperature of the centre of the inner pane.

.17 System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

.1 Inconspicuously locate vents and drain holes to prevent staining, streaking or marking of glass or framing. Size vents to provide instantaneous pressure equalization. Provide baffles to vent openings to prevent direct rainwater entry.

.2 Incorporate vertical and horizontal compartments behind exterior caps and frame-supported structural sealant glazed joints to suit spatial distribution of wind pressures.

.3 Glazing pockets vented and drained to the exteriors.

.4 All exposed end of mullions and caps to be capped and sealed while not compromising drainage quality.

.18 Air and Vapour Seal: Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound. Position thermal insulation on exterior surface of air barrier and vapour retarder. Locate air seals to prevent contact between interior humid air and exterior cold air and structure components, and to prevent moisture accumulation on these surfaces during cold weather.

.19 Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

.20 Provisions for Movement of System: Unless otherwise indicated, provide the following.

.1 Refer to structural engineer drawings and specification for design criteria.

.21 Design glass and glazing in accordance with requirements listed below:

.1 Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass as calculated in accordance with the Building Code and to withstand design pressures specified in applicable sections.

.2 Where glass extends from 1070 mm to floor, design lateral loads, in addition to other load requirements, in accordance with applicable codes.

.3 Unless otherwise specified, limit glass deflection to L/175 or flexure limit of glass with full recovery of glazing materials, whichever is less.

.4 Use a safety factor of 2.5:1 minimum for glass design.

.22 Joint Movement Capability between System and Adjacent Construction: Design expansion joints with movement capability as specified Structural Contract Administrator’s specifications or as indicated, but not less than plus or minus 50 percent of joint width, without detrimental effects to assembly and adjacent construction.

.23 Entrance System Performance Criteria: Comply with the following performance requirements, demonstrated by testing manufacturer's assemblies in accordance with test methods indicated.

.1 Air Leakage: Tested in accordance with ASTM E 283, at a static air pressure differential of 75 Pa (1.57 psf), based on door leaf module of 900 mm x 2100 mm (36” x 84”).

.2 Single Door and Frame: Maximum 2.83 cu.m./h/m (0.50 cfm/ft.) of perimeter crack.

.3 Pair of Doors and Frame: Maximum 5.66 cu.m./h/m (1.0 cfm/ft.) of perimeter crack.

.4 Structural: Door corner structural strength test using a dual moment loading criteria, minimum 132 kg (290 lbs).

.5 Forced Entry Resistance: Tests performed simultaneously with 136 kg (300 lbs) forces applied to the active door panel within 75 mm (3") of the locks in the direction that opens the door and 68 kg (150 lbs) forces applied in both perpendicular directions to the 136 kg (300 lbs) force simultaneously.

1.7 SUBMITTALS FOR REVIEW

.1 Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details and water flow drainage diagrams.

.2 Shop Drawings:

.1 Shop drawings shall bear the professional seal and signature of a Professional Engineer licensed to design structures and registered by authority having jurisdiction in the location of the Work.

.2 Furnish complete shop and erection drawings required for the work of this Section to the Contract Administrator for review prior to fabrication.

.3 Co-ordinate shop drawings for work of this Section with those for other trades to ensure correct interface details required to provide watertight installation.

.4 Shop drawings shall incorporate plans, elevations, sections and details for all work in this Section. The details shall show and specify all metal and glass thicknesses, types and finishes, areas to be sealed and sealant materials, gaskets, glazing methods, direction and magnitude of thermal expansion, type of construction including joinery, fasteners and welds, all anchorage assemblies and components, the fabrication and erection tolerances for the work in this Section and the adjoining related work of other Sections.

.5 Submit structural calculations certified by a Professional Engineer licensed to design structures and registered by authority having jurisdiction in the location of the Work, substantiating sizes for members and connections based on the design loads before commencing fabrication.

.3 Samples:

.1 Submit duplicate minimum 300 mm x 300 mm samples of each type of aluminum finish specified.

.2 Upon Contract Administrator's request furnish samples of glass types, gaskets, tapes and sealants.

1.8 SUBMITTALS FOR INFORMATION

.1 Qualifications Data: For Manufacturer and Installer. Include proof of adequate facilities and capacity to produce work.

.2 Test Reports: Submit substantiating engineering data, test results of previous tests by independent laboratory, which purport to meet performance criteria, and other supportive data. Include reports for insulating glass units and structural silicone sealant in accordance to CGSB 12.8. Test report to be within 5 years from current date.

.3 Submit test reports of the insulating glass units to be supplied as prescribed in CAN/CGSB-12.8 showing successful results. Tests shall be conducted and reports prepared by an approved, independent testing laboratory. Test report to be within 5 years from current date.

.4 Sealant Manufacturer's Certificates: Certifying that:

.1 Sealant materials selected for use are from those specified in accordance to ASTM C794.

.2 Surface preparation and application requirements have been reviewed to suit Project requirements, and instructions given to installers.

.3 Sealants are compatible with other materials and products in curtain wall assembly and adjacent construction.

.5 Installation Data: Special installation requirements.

.6 Submit Quality Control Manual outlining quality control procedures and practice encompassing all aspects of curtain wall production and installation.

.7 Submit sealant manufacturer's sealant compatibility statement that all materials in contact with structural sealants are compatible with the sealants in accordance with ASTM C1087. Submit sealant manufacturer's statement and test data confirming that sealant stress is less than 138 kPa and a safety factor of 5:1.

.8 Submit glass thermal and wind load stress analysis documenting adequate glass thickness and/or heat treatment to meet stresses generated. Thermal stress analysis to consider effects of external and internal shading, conduction at glass edge, and contribution of low-e coatings.

.9 Submit finish coating manufacturer's data: Name, address, phone number, and web site address of coating suppliers and applicators.

.10 Submit results of thermal modeling of all critical and typical cross-sections to assess both overall U value and establish condensation resistance. Results to be submitted in a format acceptable to Contract Administrator.

.11 Professional Structural Engineer's Letters of Assurance:

.1 Provide letters or completed prescribed forms signed by a professional structural engineer licensed in the Province where the Project is located, certifying that the curtain wall system has been designed, fabricated and installed in accordance with the structural performance requirements of this section and of the applicable codes, including verification that:

.1 Specified products have been used.

.2 Designs and installations as tested, have been installed on the Project.

.3 Loads and movement requirements have been achieved.

.4 Curtain wall framing designed as guards conforms to the applicable code.

.5 Summary of Design and Field review requirements.

.2 The engineer who sealed the shop drawings shall provide field review of installation and shall provide sufficient reviews in order to provide letters of professional assurance.

.12 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentations to the following:

.1 Materials & Resources:

.1 MR Credit 4 - Recycled Content: 10% & 20% (post-consumer + ½ pre-consumer)

.2 MR Credit 5 - Regional Materials: 20% & 30% Extracted and Manufactured Regionally

.2 Indoor Environmental Quality

.1 IEQ Credit 4.1 - Low-Emitting Materials: Adhesives & Sealants

.2 IEQ Credit 4.2 - Low-Emitting Materials: Paints and Coating

1.9 CLOSEOUT SUBMITTALS

.1 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in the City's name and registered with Manufacturer.

.2 Maintenance Data: For glazed aluminum curtain walls and windows; include instructions for re-glazing and as follows:

.1 Instructions covering re-glazing, adjustments, recommended cleaning procedures and other relevant maintenance data.

1.10 QUALITY ASSURANCE

.1 Perform Work in accordance with AAMA - Aluminum Curtain Wall Design Guide Manual.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum five (5) years' documented local experience, and employing a qualified Building Envelope Consultant experienced in the Province where the Project is located.

.3 Installer Qualifications: Company specializing in performing the work of this Section with minimum five (5) years' documented experience, and approved by manufacturer.

.4 Glass and glazing work under this section shall conform to the Insulating Glass Manufacturers Alliance and to the recommendations of the glass and sealed unit manufacturers.

1.11 MOCK-UP AND BUILDING ENVELOPE SITE PERFORMANCE TESTING

.1 Provide mock-up of curtain wall system for width of one structural bay including glass panels, spandrel panels, shadow boxes, fritted glass panels, intermediate mullion, corner mullion, and sill mullion. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.

.1 Include aluminum-framed entrance doors and frames indicated to be built into curtain walls as specified in related Sections.

.2 Build mockup using personnel, materials, and methods of construction that will be used at Project site.

.3 Locate where directed by Contract Administrator.

.4 Approved mock-up may remain as part of the Work.

1.12 INFILL PANEL/ SHADOW BOX MOCK-UP

.1 Submit mock-up of complete shadow box assembly for Contract Administrator review including all components necessary to illustrate final shadow box construction as specified.

.2 Build mockup using materials, and methods of construction that will be used at Project site.

.3 Size: to require location and size.

1.13 STORAGE, DELIVERY, HANDLING AND PROTECTION

.1 Handle work of this Section in accordance with AAMA - Curtain Wall Manual CW-10.

.2 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.3 Assembled units and their component parts shall be transported, handled and stored in a manner to preclude damage of any nature.

.4 Ship and store pre-glazed units in upright position only or use method which will positively prevent extrusion of sealants and shifting of glass within framing.

.5 Accessory materials required for erection at the site shall be delivered to the site in manufacturer's labelled containers.

.6 Remove all units or components which are cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace with new.

1.14 SITE CONDITIONS

.1 Provide safe and adequate equipment on the site to execute the work of this Section, including scaffolding, staging, hoisting, safety protection equipment, tools, plant and other equipment required for the completion of the work of this Section.

.2 Coordinate and verify, by measurement at the job site, all dimensions affecting the work of this Section. Submit written notifications to the Contract Administrator any field dimensions and conditions which are at variance with those on the reviewed shop drawings. The decision regarding corrective measures shall be obtained from the Contract Administrator prior to the fabrication of the item affected.

1.15 WARRANTY

.1 Provide a five (5) year warranty to correct defective Work; include coverage for complete system against failure to meet specified requirements.

.2 Provide ten (10) year manufacturer warranty for glazed units as specified in Division 08 Section Glass Glazing.

.3 Provide ten (10) year manufacturer warranty for metal finishes. Failures shall include excessive fading, non-uniformity of colour, cracking, peeling, delamination and corrosion.

.4 Warranties shall include removing and replacing covering and adjacent components and finishes. Warranty period shall recommence on remedied work.

2 Products

2.1 MANUFACTURER

.1 Specified Products: Work of this Section is based on products manufactured by Alumicor Limited. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

.1 Curtain Wall Framing:

.1 Thermally broken, ThermaWall 2600 Series.

.2 Entrance Doors:

.1 Thermally broken, ThermaPorte 7700-T600 Series

.1 Stiles: 146 mm (5-3/4")

.2 Top Rail: 143 mm (5-5/8")

.3 Center and Bottom Rail: as indicated in the drawings.

.2 Non-thermally broken, Canadiana HD-600 Series.

.1 Stiles: 146 mm (5-3/4")

.2 Top Rail: 143 mm (5-5/8")

.3 Center and Bottom Rail: as indicated in the drawings.

2.2 MATERIALS

.1 Aluminum:

.1 Extrusions: AA6063-T5 alloy, anodizing quality, conforming to ASTM B221-12.

.2 Plate and Sheet: AA1100-H14 alloy, anodizing quality unless otherwise indicated minimum 0.125" thick, conforming to ASTM B209-10, with special hardness for flat aluminum spandrel panels.

.3 Exposed surfaces of aluminum shall be free of die marks, scratches, blisters, "leave-off" marks, or other blemishes, whether left unfinished or finished.

.2 Structural Steel Sections and Steel Plate:

.1 CSA-G40.20/G40.21, Grade 260W.

.3 Galvanized Steel Sheet:

.1 Commercial grade, stretcher levelled or temper rolled, with galvanized zinc G90 (Z275) coating conforming to ASTM A653/A653M.

.4 Glass: Refer to Section 08 80 00 – Glazing for requirement.

.5 Insulation Materials:

.1 Refer to Section 07 21 00 – Thermal Insulation for requirement.

.6 Sealants:

.1 Perimeter Sealant and Backing Materials: As specified in Section 07 92 00 – Sealants. Colour to be selected by Contract Administrator.

.2 Sealant Used Within System (Not Used for Glazing): Silicone sealant as recommended by curtain wall manufacturer, and with VOC content less than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

.3 Sealing Tape for Inner Face Metal Panels of Infill Panels: Extruded polyisobutylene, ribbon-shaped, non-drying, non-skinning, non-oxidizing, reinforced, width and thickness to suit application but not less than 6 mm wide, designed to provide continuous seal.

.4 Structural Silicone Sealant: As specified in Section 07 92 00 – Sealants.

.7 Firestopping: As specified in Section 07 84 00 – Firestopping and Smokeseals.

.8 Air Vapour Barrier: As specified in Division 07 Section Air Barrier Membrane.

.9 Gap-filling foam Insulation: CAN/ULC-S710.1 single-component low VOC, low expansion bead-applied polyurethane based insulating foam sealant providing an air-tight vapour retardant flexible seal.

.10 Zinc Rich Paint For Touch-up of Galvanized Metals: Ready mixed, zinc-rich primer conforming to CAN/CGSB-1.181, Zinc Clad No. 5 Organic Zinc Rich Primer by Sherwin Williams Company of Canada Ltd., or approved alternate.

.11 Bituminous Paint: Acid and alkali resistant bituminous isolation coating.

.12 Fasteners: '400' Series stainless steel, or '300' Series stainless steel.

.13 Flexible Flashings: Flexible EPDM rubber sheet, minimum 1.5 mm (60 mils) thick, by Lexcan Limited, or by Dunlop Construction Products Inc., or by Firestone Building Products Company, or approved equal.

.14 Provide door adapters and other components as required to complete the work of this Section.

2.3 FABRICATION – GENERAL

.1 Fit and assemble component parts in shop as far as practicable. Work that cannot be permanently shop assembled shall be fitted, assembled, marked and disassembled to assure proper fitting in field. Identify shop assembled components on shop drawings for location and erection at Site.

.2 Aluminum components shall be extruded sections and shapes, unless otherwise specified or shown.

.3 Components required, for which extruded sections are not available shall be accurately formed to profiles indicated. Use minimum 1.62 mm (14 gauge) sheet aluminum unless otherwise indicated.

.4 All fastenings and connections shall be concealed unless approved by Contract Administrator.

.5 Joints between horizontal and vertical mullions shall be accurately cut and fitted. Horizontal and vertical mullions shall be in true plane with interior and exterior faces in line.

.6 Mechanically joined sections shall have "hairline" joints.

.7 Reinforce members as required to withstand loads and to maintain deflection within allowable limits.

.8 Internally reinforce framing members where work of other trades is to be fastened thereto.

.9 Fabricate expansion joints between mullion sections with formed extruded aluminum internal sleeve sections, secure to permit joint function and maintain true alignment of sections.

.10 Install air cut-offs in continuous vertical members to prevent stack effect of enclosed air columns.

.11 Framing members shall have internally formed keyed slots to receive and retain preformed gaskets, seals and thermal separators.

.12 Pressure plates shall be designed with integrally formed keyed slots to receive seals and of thickness necessary to provide permanent, uniform, sealing pressures for glazing units, without deformation.

.13 Provide inconspicuous, baffled weep holes to properly drain curtain wall cavities to exterior.

.14 Fabricate system to accommodate and interface with work of other Sections by means of rabbets, interlocks, miscellaneous angles, trim and filler sections as required.

.15 Factory glaze system modules as far as practicable. Effect glazing seal in accordance with wall system and glass manufacturer's recommendations and so as to meet specified design and performance requirements.

.16 Fabricate extruded or formed aluminum sills to profiles indicated to suit wall condition and minimum 2.4 mm (3/32") thick. Provide drip deflectors at sill ends and at abutting vertical surfaces. Open ends of sills shall be fitted with neatly applied closure plates. Anchors shall be designed not to work loose after installation. Unless otherwise detailed provide "flush" slip joint at intermediate sill joints.

.17 Prepare aluminum curtain wall framing for installation of doors, finish door hardware including, but not limited to; deadlocks, handicap power door operators and other door finish hardware as specified within these documents.

.18 Install all door hardware on doors. Test all doors on completion of installation and adjust as required for smooth and efficient operation.

.19 Form covers, closures, mouldings and trim integral with, or immediately adjacent to work of this Section to profiles indicated on drawings, and as required for a complete installation.

2.4 FABRICATION – INFILL PANELS

.1 Fabricate in accordance with reviewed shop drawings, and mock-ups.

.2 Outer Face:

.1 Sealed insulating glass unit, see Section 08 80 00 – Glazing for requirement.

.3 Back up pan:

.1 Fabricate back-up pans from formed sheet as indicated below and braced as required to resist specified forces with sealed corners:

.1 Aluminum: 3mm thick sheet with aluminum finish to match curtain wall mullion finish.

.2 Insulation:

.1 Adhesive bond impaling pins to panels at 300 mm (12") on center each way for securement of insulation.

.2 Install spandrel panel insulation in back-up pans and held in place by insulation fasteners (impale clips) to form continuous thermal barrier behind spandrel panels.

.3 Insulation Fasteners: Impaling clip of plastic or nylon with washer retainer, to be adhered to surface to receive board insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

2.5 FINISHES

.1 Aluminum Finish:

.1 Clear Anodic Finish: AA-M12C22A41, as fabricated nonspecular mechanical finish, medium matte etched chemical finish, architectural class I clear anodic coating of minimum 0.018 mm (0.7 mil) thick complying with AAMA 611.

3 Execution

3.1 EXAMINATION

.1 Check structural elements and adjoining work of other Sections on which work of this Section is dependent, verify governing dimensions, floor elevations, floor to floor heights, minimum clearances between curtain wall and structural frame. Confirm that conditions are satisfactory before proceeding. Commencement of work of this Section indicates acceptance of surfaces and conditions.

3.2 ERECTION

.1 Erect curtain wall system plumb, level and square, in correct relation to work of other Sections, within a maximum non-cumulative deviation of 1/8" per 12'-0" length of member, and with members accurately fitted and aligned at joints and intersections.

.2 Anchor system to building structure, adjusting as required to meet erection tolerances and secure to prevent movement other than that which is expected due to structural deflection and creep and thermal expansion and contraction.

.3 Provide all devices and components required for erection of system.

.4 Provide flashings, fillers, covers and sealants indicated and as required to render system weathertight and to meet specified performance criteria. Ensure effective seal at laps, end joints and changes of direction.

.5 Provide continuity of thermal and air seal/vapour barriers with adjacent thermal and air seal/vapour barrier systems. Pack spaces between frames and adjacent building elements and where shown with fibrous insulation.

.6 Install glass panels and glazing materials in accordance with Section 08 80 00 – Glazing, to glazing method required to achieve performance requirements.

.7 Seal joints between wall system and adjacent building elements with sealant in strict accordance with requirements of Section 07 92 00 – Sealants.

.8 Use concealed fastenings only.

.9 Touch up steel anchoring components, after installation, with zinc rich paint.

3.3 ERECTION TOLERANCES

.1 Install glazed aluminum curtain wall systems to the following maximum tolerances:

.1 Plumb: 3 mm (1/8") in 3000 mm (10') with aggregate total not exceeding 6 mm (1/4") in 12.2 m (40').

.2 Level: 3 mm (1/8") in 6 m (20') with aggregate total not exceeding 6 mm (1/4") in 12.2 m (40').

.3 Alignment: Limit misalignment of two adjoining glass panes abutting in the same plane as follows:

.1 Limit offset from true alignment to 1.5 mm (1/16") where surfaces meet in-line or are separated by reveal or protruding element up to 12 mm (1/2") wide.

.2 Limit offset from true alignment to 3 mm (1/8") where surfaces are separated by reveal or protruding element from 12 mm (1/2") to 25 mm (1") wide.

.3 Limit offset from true alignment to 6 mm (1/4") where surfaces are separated by reveal or protruding element of 25 mm (1") or wider.

.4 Joint Width: Maintain sealant space between glass and adjacent construction to an average of 5/8", with a variation of no more than +3 mm (1/8") and 6 mm (1/4").

.5 Location: Limit variation from plane to 3 mm (1/8") in 300 mm (12") with aggregate total not exceeding 12 mm (1/2") over total length.

3.4 MANUFACTURER'S SITE SERVICES

.1 Curtain wall product manufacturer to provide field surveillance of the installation of their Products.

.2 Schedule manufacturer's review of work procedures at stages listed:

.1 Product Application: 1 off site review.

.2 Fabrication and Handling: 1 review at authorized installers fabrication facilities.

.3 Installation: 3 site reviews at commencement of Work; 50% completion of Work and upon completion of Work.

.3 Submit manufacturer's written reports to Contract Administrator describing:

.1 The scope of work requested.

.2 Date, time and location.

.3 Procedures performed.

.4 Observed or detected non-compliances or inconsistencies with manufacturers' recommended instructions.

.5 Limitations or disclaimers regarding the procedures performed.

.6 Obtain reports within seven days of review and submit immediately to Contract Administrator.

.4 Monitor and report installation procedures and unacceptable conditions.

3.5 SITE QUALITY CONTROL

.1 Professional Structural Engineer Inspections: Engage professional structural engineer experienced in design and installation of this work and licensed in the Province where the Project is located, to perform inspections.

.1 Perform timely and regular inspections.

.2 Verify installation conforms to applicable building code.

.3 Prepare and submit inspection forms required by applicable building code.

.2 Curtain Wall Tests and Inspections:

.1 Structural-Sealant Compatibility and Adhesion: Structural sealant shall be tested according to recommendations in ASTM C1401 using Destructive Test Method A, Hand Pull Tab (Destructive), Appendix X2.

.1 Test minimum of four areas on each building face.

.2 Repair installation areas damaged by testing.

.2 Structural-Sealant Glazing Inspection: After installation of metal-framed systems is complete, structural-sealant glazing shall be inspected and evaluated according to recommendations in ASTM C1401.

.3 Remove and replace nonconforming work and retest as specified at Contractor's cost.

3.6 FINAL CLEANING

.1 Remove protective coatings and coverings from prefinished components; clean structural components and fittings; remove excess sealants and other substances that detract from finished appearance after completion of installation.

.2 At completion of work of this Section, remove all labels from glass and clean inner and outer faces of glass and all exposed metal surfaces at interior and exterior. Replace scratched or broken glass and make good any damaged materials, all in accordance with Section 01 70 00.

.3 Coordinate protective measures required to prevent damage or deterioration of structural glass system from subsequent construction activities.

3.7 PROTECTION OF FINISHED WORK

.1 Protect finished Work from damage.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Provision of all labour, materials, equipment, and incidental services necessary to supply finish hardware, including the following:

.1 Supply and delivery to the project all items of architectural finishing hardware specified herein,

.2 Supply and installation of low-energy door operators and hardware,

.3 Supply and installation of all electrical hardware items including, but not limited to; low voltage wire (FT6 plenum-rated when not in conduit), electric strikes, electric exit devices, current transfer devices, wall switches, jamb switches, keypads, controllers, power supplies, and

.4 Completion of all low voltage terminations by the hardware supplier

1.3 RELATED REQUIREMENTS

.1 Coordinate with Work of other Sections having a direct bearing on Work of this Section.

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards

.2 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.3 Standards:

.1 ANSI-A250.4 - Steel Doors and Frames Physical Endurance

.2 ANSI A156.1 - Butts and Hinges

.3 ANSI A156.3 - Exit Devices

.4 ANSI A156.4 - Door Controls - Door Closers

.5 ANSI A156.5 - Cylinders and Input Devices for Locks

.6 ANSI A156.5 - Auxiliary Locks and Associated Products

.7 ANSI A156.6 - Architectural Door Trim

.8 ANSI A156.7 - Template Hinge Dimensions

.9 ANSI A156.8 - Door Controls - Overhead Holders

.10 ANSI A156-10 - Power Operated Pedestrian Doors

.11 ANSI A156.13 - Mortise Locks and Latches

.12 ANSI A156.14 - Sliding and Folding Door Hardware

.13 ANSI A156.15 - Closer Holder Release Devices

.14 ANSI A156.16 - Auxiliary Hardware

.15 ANSI A156.18 - Material and Finishes

.16 ANSI A156.19 - Power Assist and Low Energy Power Operated Doors

.17 ANSI A156.21 - Thresholds

.18 ANSI A156.22 - Door Gasketing and Edge Sealing Systems

.19 ANSI A156.25 - Electrified Locking Devices

.20 ANSI A156.26 - Continuous Hinges

.21 ANSI A156.30 - High Security Cylinders

.22 ANSI A156.31 - Electric Strikes and Frame Mounted Actuators

.23 ANSI A250.4 - Steel Doors and Frames Physical Endurance

.24 NFPA 80 - Standard for Fire Doors and Other Opening Protectives

.25 NFPA 101 - Life Safety Code

.26 Manitoba Building Code

.27 ANSI A117.1 - Accessible and Usable Buildings and Facilities

.28 2015 City of Winnipeg Accessibility Design Standard Third Edition

1.5 DEFINITIONS

.1 Architectural Hardware Consultant (AHC): person or persons skilled in selecting, coordinating, and specifying architectural hardware, and certified by the Door and Hardware Institute.

.2 Hardware Supplier: company or group of companies whose purpose is the manufacture and supply of architectural finish hardware.

.3 Hardware Distributor: company whose purpose is the distribution of architectural finish hardware.

1.6 QUALITY ASSURANCE

.1 Products

.1 Products specified herein are minimum standard. Approved substitutions are listed. Products proposed as substitutions must be accepted by addenda prior to Bid Closing.

.2 Hardware for doors in fire separations and exit doors must be certified by a Canadian Certification Organization accredited by Standards Council of Canada. Supply only ULC and/or CSA listed electrical components.

.3 Hardware Suppliers

.1 Hardware Suppliers must have in their employ a certified Architectural Hardware Consultant (AHC) certified by the Door and Hardware Institute.

.2 The Hardware Supplier will provide following services to the Contract:

.1 preparation of the hardware schedule issued for tender,

.2 review of all shop drawings,

.3 provision of requested samples,

.4 review of hardware substitution submittals, and

.5 provision of all inspections and reports as specified herein.

.4 Hardware Distributors

.1 The Distributor must have a minimum of five (5) years documented experience in the supply of Finish Hardware for similar projects.

.2 Hardware Distributors must have in their employ a certified Architectural Hardware Consultant (AHC) certified by the Door and Hardware Institute.

.3 The Hardware Distributor will assume responsibility that the Products supplied under this section meet or exceed the minimum requirements of the specifications, the hardware schedule, and all authorities having jurisdiction.

.5 Installers

.1 Hardware Installers must have a minimum of five (5) years' experience in installation of hardware. The Contractor shall provide verification of installer's qualification to the Contract Administrator for approval. Installers to attend all review meetings with the Hardware Supplier and Distributor.

.6 Pre-installation Meeting

.1 Convene a pre-installation meeting for the work specified in this section. Attendees must include, as a minimum, representatives of the following:

.1 Contractor (Site Superintendent & Project Manager)

.2 Installation Subcontractor (Site Foreman & Project Manager)

.3 Hardware Supplier (AHC)

.4 Hardware Distributor (AHC and Installer)

.5 Related Subcontractors (ie. Electrical, Security Systems)

.6 Contract Administrator

1.7 SUBMITTALS

.1 Updated Finish Hardware Schedule

.1 Prepare and submit detailed hardware schedules prepared in 216 mm x 279 mm DHI format.

.2 Product Information

.1 Submit product data sheets, hardware templates for installation with the finish hardware schedule showing all items of hardware to be used on the project.

.3 Samples

.1 When requested in writing, provide one sample of each hardware item requested complete with fasteners to the office of the Contract Administrator . Samples to be clearly labeled with their hardware schedule designation and manufacturers' name and model number. Samples may be incorporated into the Work.

.4 Keying Schedule

.1 Submit keying schedule for review. Include all special keying notes and stamping instructions. Locks and cylinders are not to be ordered until the key schedule has been approved by the City.

.5 Wiring Diagrams

.1 Provide a written description of the functional use of all electrical hardware. Include door and frame elevations showing the location of each item of electrical hardware to be installed, including a diagram showing number and size of all conductors. Include drawings showing all terminal connections. Where electrical hardware is to be supplied and installed provide the Contractor with riser

diagrams listing the correct wire runs and back box sizes as well as 115V AC requirements.

.6 Operations and Maintenance Data

.1 Prior to Substantial Performance, submit the following information for inclusion in Operation and Maintenance Manuals:

.1 Maintenance instructions for each hardware item,

.2 Catalogue cut sheets and Product Specifications or each product,

.3 Parts list for each product,

.4 Copy of final “as-built” finish hardware schedule, and

.5 Copy of final keying schedule.

.7 Maintenance Materials

.1 Provide five (5) of each installation tool used for locks/passage/privacy, all type of door closers, and all exit devices.

.8 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentations to the following:

.1 Materials & Resources:

.1 MR Credit 4 - Recycled Content: 10% & 20% (post-consumer + ½ pre-consumer)

.2 MR Credit 5 - Regional Materials: 20% & 30% Extracted and Manufactured Regionally

.2 Indoor Environmental Quality

.1 IEQ Credit 4.1 - Low-Emitting Materials: Adhesives & Sealants

.2 IEQ Credit 4.2 - Low-Emitting Materials: Paints and Coating

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Deliver each hardware item in its original package complete with all fasteners, keys, templates, and installation instructions required for installation.

.2 Package hardware separately for each door or unit and state clearly on each package the number and description of the door or unit for which the hardware therein is intended. Group items accordingly.

.3 Clearly mark each container with the door opening number and the hardware schedule item or heading number.

.4 Store hardware in a locked room or other secure area, accessible by only the Contractor. Storage area must contain adequate storage provision to hold all hardware off the floor (temporary shelving or wood pallets). Ensure area is kept dry and clean.

.5 When requested, package items of hardware separately for delivery to other fabricators for their installation.

.6 Deliver and assist in unloading and sorting of hardware. All hardware must be checked in on site by the Contractor's Site Supervisor.

1.9 COORDINATION WITH OTHER TRADES

.1 Supply finish hardware to those who are to install it, complete with templates and other complete installation instructions in sufficient time to avoid delaying the progress of the work.

.2 Supply complete templates and instructions to all door and frame manufacturers for factory machining of products to receive Hardware.

1.10 INSPECTION

.1 Hardware Distributor must perform the following inspections:

.1 Check all hardware when it has been installed and notify the Contract Administrator of improper installation, defective materials, or products installed that were not specified. Replace defective hardware promptly.

.2 Check all door closers after they have been installed to make sure that all adjustments such as back-checking degree have been properly made. Notify the Contract Administrator of any closers which have not been properly adjusted.

1.11 MAINTENANCE

.1 Maintenance Service

.1 Following occupancy of the building by the City, arrange with the City's maintenance staff for instruction of proper use, servicing, adjusting and lubrication of all finish hardware. Submit to the Contract Administrator a list of attendees and meeting date.

1.12 EXTENDED WARRANTIES

.1 Provide the following manufacturer's warranties beyond the date of expiration of the Contract warranty:

.1 Hinges - Lifetime

.2 Electrified Hinges – One (1) year

.3 Mortise locksets - Seven (7) years

.4 Electrified Locksets – Two (2) years

.5 Exit Devices - Five (5) years

.6 Door closers - Ten (10) years

.7 Electric Strikes – Five (5) years

2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Subject to conformance to requirements provide hardware manufactured by the following:

.1 Dorma Group of Companies.

.2 ASSA-ABLOY Group of Companies.

.3 Allegion Group of companies.

2.2 MATERIALS

.1 Fabricate all hardware to template. Provide templates and template hardware together with the instructions necessary for door and frame preparation.

.2 Supply all hardware with necessary screws, bolts or other fastening devices to anchor hardware in position neatly and properly in accordance with best practices.

.3 Only products listed in the hardware schedule or the approved alternates noted in the following list are to be used on this project.

.4 Use one manufacturer's products only for all similar items.

.5 All exterior doors shall be fitted with complete perimeter weatherstripping and threshold where not provided by door or frame manufacturer.

.6 No substitutions are allowed for the following products, due to integration with existing hardware:

.1 Locksets, Latchsets, and Privacy Sets.

.2 Panic Sets

.3 Door Closers.

2.3 FASTENINGS

.1 Supply all required bolts, screws, expansion shields, anchors, and other related accessories for satisfactory attaching or installing of all finish hardware.

.2 Exposed fasteners shall match finish of, and be of compatible material with hardware.

.3 Where push/pull hardware is scheduled, door pull must be through-fastened and have fasteners concealed by push plate on opposite side.

2.4 HINGES

.1 Butt Hinges: ANSI/BHMA-A156.1, Grade 1.

.1 Supply hinges with non-removable pin (NRP) option on all doors where the hinge barrel is exposed on the secured exterior side of the door.

.2 Use two hinges on doors up to 1525mm and an additional hinge for each additional 760mm or fraction thereof.

.3 Doors 914mm wide and less: 114mm high hinges; doors greater than 914mm to 1220 mm wide: 127mm high hinges; all standard weight.

.4 Supply standard weight and heavy weight concealed bearing hinges on all doors equipped with door closers; ferrous (steel) material for all interior and/or fire-rated doors and stainless steel for exterior doors as listed in the hardware groups.

2.5 SURFACE/FLUSH BOLTS

.1 Surface/Flush Bolts: ANSI/BHMA-A156.16, Grade 1.

.1 Surface Bolts

.1 Surface bolts to have 25mm throw with vandal-resistant concealed mounting. Units to be constructed of heavy duty steel and be ULC listed up to three (3) hours when used on the inactive door of a pair up to 2440mm in height.

.2 Manual Flush Bolts-Metal Doors

.1 Manual flush bolt for metal doors to be ULC listed for 3-hour fire doors with 13mm diameter bolt tip, 19mm throw. Rod length to be 305mm. Supply dustproof strikes with all flushbolts.

.3 Manual Flush Bolt-Wood Doors

.1 Manual flush bolt for wood doors to be ULC listed for 90min fire doors with 19mm throw with a 22mm vertical adjustment. Supply dustproof strikes with all flushbolts.

.4 Automatic Flush Bolts-Metal Doors

.1 Automatic flush bolts for metal doors, fully automatic, ULC listed for 3 hour fire doors, low actuation forces, top bolt has spring tension, non-

handed with 19mm throw with a 22mm vertical adjustment. Optional rod length for non-rated openings. Auxiliary fire latch that eliminates the bottom bolt for ULC listed doors. Supply dustproof strikes with all flushbolts.

.5 Automatic Flush Bolts- Wood Doors

.1 Automatic flush bolts for wood doors to be fully automatic ULC listed for 90min fire doors, low actuation forces, top bolt has spring tension, non-handed with 19mm throw with a 22mm vertical adjustment. Auxiliary fire latch that eliminates the bottom bolt for ULC listed doors (20min only). Supply dustproof strikes with all flushbolts.

2.6 LOCKSETS, LATCHSETS, DEADLOCKS

.1 Grade 1 Deadbolt

.1 ANSI/BHMA-A156.5, Grade 1 deadbolt supplied with solid brass or bronze trim rings and 25mm throw high-strength, steel alloy deadbolt with hardened steel roller resistant to sawing and kick-in attacks. Metal shield protects bolt from attack through the door as well as hardened steel balls that protect mounting screws from drill attack. Exclusive wood frame reinforcer protects wood jamb against kick-in attacks.

.2 Grade 1 Cylindrical

.1 ANSI/BHMA-A156.2, Grade 1 extra heavy duty residential, commercial, institutional and industrial applications. Latch bolts to be steel with minimum 13mm throw deadlocking on keyed and exterior functions. 19mm throw anti-friction latchbolt on pairs of fire doors. Provide manufacturer's standard wrought box strike for each latch or lock, with curved lip extended to protect frame. Lock case to be steel. Locks to incorporate one piece spring cage and spindle. Precision solid brass 6-pin cylinder with nickel silver keys. All levers to be solid with no plastic inserts. Locks and latchsets tested to exceed 3,000,000 cycles.

.3 Grade 1 Mortise

.1 ANSI/BHMA-A156.13, Grade 1 Operational, Grade 1 Security, mortise lock for commercial and institutional buildings. Lock cases to have a high strength steel alloy cylinder retainer with a captured ¼-20 set screw. Lock case to be field reversible without chassis disassembly. Supply locksets with lock cases manufactured from 2.7mm steel with internal components of steel with zinc-dichromate plating for corrosion resistance. Case cover to be secured with four screws for increased rigidity. Locks are to feature a full 19mm throw two-piece stainless steel mechanical anti-friction latchbolt with 25mm throw deadbolt constructed of sintered stainless steel. Deadbolt to remain a minimum of 16mm within lock case when fully extended. All mortise locks are to feature external spring cages. Stop works functions to be by turn unit. Lock cases with stop works on edge of lock case will not be accepted. Spindles to be such that if forced it will twist first, then break (approx. 81.3 N/m of torque).

.4 All Grade 1 and Grade 2 cylindrical lever locksets shall have a free wheeling or clutch mechanism so the lever moves when in the locked position without retracting the latch bolt.

2.7 EXIT DEVICES

.1 Narrow Style: ANSI/BHMA-A156.3, Grade 1 ULC listed for panic hardware and fire exit hardware. Supply exit devices with smooth mechanism case and "the quiet one" fluid dampener to eliminate noise associated with exit device operations. Non-handed device with touchpad assemblies with no exposed fasteners and cast end caps, reinforced

aluminum with stainless steel touchpad and raised edge to minimize pinching. Fits door stiles as narrow as 45mm.

.2 Heavy Duty: ANSI/BHMA-A156.3, Grade 1 ULC listed for panic hardware and fire exit hardware. Supply exit devices and fire exit devices featuring coil compression springs on all device mechanism subassemblies and dead latching mechanisms for all active latchbolts. Supply exit devices with smooth mechanism case and “the quiet one” fluid dampener to eliminate noise associated with exit device operations. Non-handed device with touchpad assemblies with no exposed fasteners and cast end caps, reinforced aluminum with stainless steel touchpad and raised edge to minimize pinching. Roller strikes to be standard on all rim and surface vertical rod devices. Doors greater than 914mm wide supply long bar exit devices, doors 2134mm high and greater supply extension rods. 1,000,000 cycle testing independently certified by ETL.

.3 Device Trim

.1 Supply device trim featuring recessed cylinder mounting and coil compression spring design with shear pin protection for all lever designs. Similar lever designs for exits as specified for locksets.

.4 Mullions Non-Rated

.1 Aluminum mullions complete with mullion stabilizers prepared with strikes for use with all rim devices to provide single door performance and security on double door applications.

.2 Steel mullion prepared for two strikes for use with all rim devices and key removable kit to provide quick removal to provide single door performance and security on double door applications.

.5 Mullions Rated

.1 Fire rated ULC approved mullion for up to three hour openings up to 2.4m x 2.4m using rim devices prepared for strikes. Supply with key removable kit to provide quick removal to provide single door performance and security on double door applications.

.6 Exit devices installed on exterior doors must have dead latching bolts to ensure tamper proof security.

2.8 DOOR CLOSERS

.1 Door closers to be Grade 1 ANSI/BMHA A156.4, and have the following features (see separate closer sections below for further information):

.1 Fully hydraulic, rack and pinion action with high strength cast iron cylinders and one piece forged steel pistons.

.2 Hydraulic fluid of a type requires no seasonal adjustments, and has constant temperature control from 49^{o}C to –35^{o}C.

.3 Hydraulic regulation controlled by tamper-proof, non-critical screw valves, adjustable with a hex wrench.

.4 Separate adjustments for backcheck, general speed and latch speed.

.5 Include high efficiency, low friction pinion bearings.

.6 Size 1 manual door closers to provide less than 22N opening force on a 914mm door leaf.

.7 Closers with painted finishes shall exceed a minimum 100-hour salt spray test, as described in ANSI/BHMA-A156 and ASTM B117.

.8 Closers detailed with plated finishes shall include plated covers (or finish plates), arms and visible fasteners.

.9 Provided with all mounting plates required to mount on any special door and frame conditions.

.2 Medium Duty Mechanical (Interior/Exterior)

.1 ANSI/BHMA-A156.4, non-sized (1-6) and non-handed cylinder body to have 32mm piston diameter with 16mm single heat-treated shaft. Track closer cylinder body non-sized (2-4) or (1-2). Closers to have stamped main arm and forearm (forged steel main arm and forearm EDA and CUSH type arms). Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

.3 Medium Duty Mechanical (Interior)

.1 ANSI/BHMA-A156.4, non-sized (1-4) and non-handed cylinder body. Track closer cylinder body non-sized (1-3). Closers to have stamped main arm and forearm (forged steel main arm and forearm EDA and CUSH type arms). Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck. Closer to have standard metal cover not to exceed 45mm from face of the door.

.4 Heavy Duty Mechanical (Pull Side Mount)

.1 ANSI/BHMA-A156.4, non-sized (1-5) and handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft and certified to exceed ten million (10,000,000) full load operating cycles by a recognized independent testing laboratory. Track closers sized 1, 3 or 4. Closers to have forged steel main arm. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

.5 Heavy Duty Mechanical (Top Jamb Mount)

.1 ANSI/BHMA-A156.4, non-sized (1-5) and handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft and certified to exceed ten million (10,000,000) full load operating cycles by a recognized independent testing laboratory. Track closers sized 1, 3 or 4. Closers to have forged steel main arm. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

.6 Medium Duty Mechanical (Interior-Pull Side Mount)

.1 ANSI/BHMA-A156.4, sized (1, 2, 3 or 4) and handed cylinder body to have 32mm piston diameter with 16mm single heat-treated shaft. Closers to have forged steel main arms. Optional arms to be interchangeable within the series of closers. Standard plastic cover not to exceed 41mm from face of door.

.7 Heavy Duty Mechanical (Multiple Applications)

.1 ANSI/BHMA-A156.4, non-sized (1-6) and non-handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft and certified to exceed ten million (10,000,000) full load operating cycles by a recognized independent testing laboratory with power-adjust speed dial to show spring size

power. Track closers non-sized 1-4. Closers to have stamped main arm and forearm (forged steel main arm and forearm EDA and CUSH type arms). Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

.8 Heavy Duty Mechanical (Parallel Arm Mount)

.1 ANSI/BHMA-A156.4, non-sized (1-5) and handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft and certified to exceed ten million (10,000,000) full load operating cycles by a recognized independent testing laboratory. Track closers sized 1, 3, or 4. Closers to have forged steel main arm and forearms. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

.9 Medium Duty Mechanical (Interior-Push Side Mount)

.1 ANSI/BHMA-A156.4, sized (1, 2, 3 or 4) and handed cylinder body to have 32mm piston diameter with 16mm single heat-treated shaft. Closers to have forged steel main arm and forearms. Optional arms to be interchangeable within the series of closers. Standard plastic cover not to exceed 41mm from face of door.

.10 Heavy Duty Single Point Hold-Open (Pull and Push Side Mount):

.1 ANSI/BHMA-A156.4, non-sized (1-4) and non-handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft with adjustable single-point hold open function controlled by solenoid assembly located in a head frame mounted track. Track arm to have single lever arm with low friction track and roller assembly. Unit to have a momentary on/off switch board assembly for testing door release and also provides over-voltage protection.

.11 Heavy Duty Multi-Point Hold-Open (Pull Side Mount):

.1 ANSI/BHMA-A156.4. Provide closer/holder designed to hold open the door in the open position under normal usage and to release and automatically close the door under fire conditions. Closer will include an integral Electro-magnetic holder mechanism designed for use with ULC listed fire detectors, provided with normally closed switches. Sized (3 or 4) and handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft with multi-point hold open function controlled by solenoid in the cylinder assembly. Track arm to have single lever arm with low friction track and roller assembly with swing free function with no-drift feature. Unit to have a momentary on/off switch board assembly for testing door release and also provides over-voltage protection. Where detailed multi-point closer/holders shall incorporate a hold open bypass feature from 0 degrees up to either 80 degrees or 140 degrees.

.12 Heavy Duty Multi-Point (Push Side Mount):

.1 ANSI/BHMA-A156.4. Provide closer/holder designed to hold open the door in the open position under normal usage and to release and automatically close the door under fire conditions. Closer will include an integral Electro-magnetic holder mechanism designed for use with ULC listed fire detectors, provided with normally closed switches. Sized (3 or 4) and handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft with multi-point hold open function controlled by solenoid in the cylinder assembly. Unit to be supplied with forged steel main arm. Unit to have a momentary on/off switch board assembly for testing door release and also provides over-voltage protection. Where

detailed multi-point closer/holders shall incorporate a hold open bypass feature from 0 degrees up to either 80 degrees or 140 degrees.

2.9 DOOR OPERATORS

.1 Heavy Duty Electric Operator (Push Side Mount)

.1 ANSI/BHMA-A156.19, non-sized (2-5) and non-handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft. With forged steel main arm. Power operator to include:

.1 Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical code.

.2 Second Chance Function: program within the on-board computer monitoring resistance during opening cycle. If resistance is present operator pauses for a few seconds, then attempts to open door again. If resistance does not exist door will open normally. However if resistance still exists, door will pause and the unit will time out and door will close.

.3 Breakaway Drive System: System within the motor/clutch assembly. If the door is forced closed while in the opening cycle, the clutch slips preventing damage to the operator, door and frame.

.4 Soft Start Motor Control: required for controlled start once actuator is depressed to extend the service life of all drives components.

.5 Built in Power Supply to deliver 12V and 24V outputs up to a maximum of 1.0 amp.

.6 Certified by ULC for use on labeled doors.

.7 Independent adjustments for all electrically controlled functions within controller module.

.2 Heavy Duty Electric Operator (Pull Side Mount):

.1 ANSI/BHMA-A156.19, non-sized (1-4) and non-handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft. Track arm to have single lever arm with low friction track and roller assembly. Power operator to include:

.1 Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical code.

.2 Second Chance Function: program within the on-board computer monitoring resistance during opening cycle. If resistance is present operator pauses for a few seconds, then attempts to open door again. If resistance does not exist door will open normally. However if resistance still exists, door will pause and the unit will time out and door will close.

.3 Breakaway Drive System: System within the motor/clutch assembly. If the door is forced closed while in the opening cycle, the clutch slips preventing damage to the operator, door and frame.

.4 Soft Start Motor Control: required for controlled start once actuator is depressed to extend the service life of all drives components.

.5 Built in Power Supply to deliver 12V and 24V outputs up to a maximum of 1.0 amp.

.6 Certified by ULC for use on labeled doors.

.7 Independent adjustments for all electrically controlled functions within controller module.

.3 Actuators

.1 Wall Type

.1 Wall plate switch to be hard-wired either 12V DC or 24V DC actuator with round, stainless steel touch plate in either 114mm or 152mm diameters. Engraved blue filled handicap symbol conforms to most accessibility codes. Units to include heavy grade components for vandal resistant mounting and weather resistant switch standard.

.4 Low energy door operators will be supplied and installed by factory trained installers. Hardware supplier will coordinate the installation of the door operators and include the cost of labour for this work.

2.10 PULLS AND PLATES

.1 Supply door trim as listed in hardware schedule. Supply pulls with back to back (BTB) or through bolt mounting as required. When push plates are listed with door pulls, install the push plate to conceal the through bolt.

.2 All kickplates, push plates, and bumper plates must have all sides beveled and corners rounded to ensure no sharp edges. Supply plates with counter sunk screw holes. Supply double-sided tape for adhesive-mount.

.3 Kick plates will be minimum 0.127mm thick unless listed otherwise; size to be door width less 35mm for single door, and less 25mm for pairs of doors. Heights as scheduled.

2.11 DOOR STOPS AND HOLDERS

.1 Floor Stops (Doors without Threshold)

.1 ANSI/BHMA-A156.6. Floor stops to be 25mm overall height with 4.8mm base height for use on doors without thresholds. Heavy-duty cast dome stop constructed of brass/bronze with gray, non-marring rubber bumper.

.2 Floor Stops (Doors with threshold or undercut doors)

.1 ANSI/BHMA-A156.6. Floor stops to be 25mm overall height with 14.3mm base height for use on doors with thresholds or undercut doors. Heavy-duty cast dome stop constructed of brass/bronze with gray, non-marring rubber bumper.

.3 Wall Stops (No Button on Locking Hardware)

.1 ANSI/BHMA-A156.6. Wall stops to be constructed of heavy-duty brass base with special retainer cup that makes the rubber stop tamper resistant. Convex design of rubber bumper.

.4 Wall Stops (Projecting Button on Locking Hardware)

.1 ANSI/BHMA-A156.6. Wall stops to be constructed of heavy-duty brass base with special retainer cup that makes the rubber stop tamper resistant. Concave rubber bumper to avoid damage to locks with projecting buttons.

.5 Supply wall stops where wall conditions are sufficient to support impact loads, such as stud partitions with wood blocking, masonry, or concrete. Supply floor stops with sufficient height to suite the floor condition or undercut of doors.

.6 Overhead stops and mechanical holders shall be surface mounted unless a conflict exists with door closers or other hardware. Provide door stays with friction action in locations that do not have door closers. Install all overhead stops and holders for 90° stop unless otherwise specified.

.7 Electronic door holders will be supplied tri-voltage and be connected to the fire alarm system by Division 28 to release the door when signaled.

2.12 DOOR SEALS

.1 Supply perimeter seals to fully cover all gaps between door, frame, and floor condition to seal against weather, sound, or smoke as required and scheduled.

.2 Frame gaskets shall be closed cell neoprene. Extruded housing must have a rib to prevent distortion during installation. Aluminum frames will be provided with weather stripping inserts by the frame supplier.

.3 Door bottoms will be heavy-duty and have an adjustment screw to ensure proper contact with flooring. Supply correct drop insert for carpet where required.

2.13 THRESHOLDS

.1 Supply extruded aluminum thresholds to ensure the sweep or door bottom makes full contact. Supply thermally broken thresholds for all exterior door openings.

.2 Threshold height shall not exceed 13mm for barrier-free path of travel.

2.14 EMERGENCY CALL SYSTEM

.1 Provide emergency call system in universal washrooms in accordance with applicable code requirements and authority having jurisdiction.

.2 Emergency button: Consisting of audio and visual signal devices activated inside washroom.

.3 Universal Washroom Hardware and Emergency Kit: By Camden Door Controls:

.1 Emergency Push Button (E-PB): CM-450R/12

.2 Emergency Indicator and Sounder (E-IS): CM-AF501SO.

.3 Emergency Dome Light and Sounder(E-DLS): CM-AF141SO.

.4 Notice Sign:

.5 English (S-E): CM-SE21A.

.6 French (S-F): CM-SF20A.

.7 Advanced Logic Relay: CX-33.

.8 Push to Lock Button (PLB): CM-400/8.

.9 Occupied Indicator (OID): CM-AF500.

.10 Door Contact Switch: CX-MDS.

.11 Electric Strike: CX-EU2018/2015 or other compatible.

.12 Power Supply: CX-PS13 12/24V.

.13 Transformer: CX-TRX-4024.

.4 Coordinate electrical power supply with Division 26.

2.15 ELECTRONIC HARDWARE

.1 Keyswitch

.1 Keyswitch housing to be cast zinc to protect against vandalism, housing to provide a concealed rear mounting attachment which cannot be compromised when the cylinder is attached with a set screw. Standard stainless steel cover plate.

.2 Electric Strikes

.1 ANSI/BHMA-A156.31, Grade 1. Electric strikes to be ULC listed burglary-resistant and electric strike for fire doors and frames; "A" label for single doors and "B" label for double doors. Electric strikes to be stainless steel construction, non-handed available in 12V or 24V AC or DC with continuous duty solenoid and accept 19mm throw latchbolts. Strike box to be adjustable to compensate for any misalignment of the door or frame with two piece plug connector for ease of installation.

.3 Power Supplies

.1 Power supplies to be Underwriter Laboratories (UL) listed for general-purpose use tested to meet UL1012 specifications. Power supplies to have 12/24V DC field selectable output voltage with output current of 3 amps at 12V DC and 2 amps at 24V DC with supply output voltage filtered and regulated. The power supply to be inherently modular by design for ease of installation and to provide flexibility for future system modifications when necessary.

.4 Include power supplies that are compatible with magnetic lock and have a NFPA-101 fire alarm release. Reset key switch will be centrally located and will re-arm all the magnetic locks in the building.

.5 Access control will be frame-mounted stand-alone keypad complete with adjustable time delay. Units will have all functions keypad programmable, 12 or 24 volt AC/DC with a code length of 3-6 digits.

.6 Electronic hardware will be supplied and installed by this section, including all low voltage device wiring.

2.16 FINISHES

.1 Finishes are specified as follows:

.1 As indicated on Finish hardware schedule.

2.17 KEYING

.1 General

.1 Architectural Hardware Consultant (AHC) will meet with the City to obtain and finalize all keying requirements, and will subsequently issue copies of the keying schedule for review.

.2 Provide temporary construction keying system during construction period. Permanent keys will be furnished to the City prior to occupancy. The City or City's Agent will void the operation of the construction keys.

.3 Key Material: Provide manufacturer's standard embossed keys of nickel silver to ensure durability.

.4 Key Quantity: Furnish keys in the following quantities:

.1	Temporary construction keys:	10 each.
.2	Grand Master keys per grand master group:	6 each.
.3	Master keys per master group:	6 each.
.4	Change keys per cylinder or keyed alike group:	4 each.
.5	5 Extractor tools each.	

.5 Deliver all permanent key blanks and security keys direct to City from factory by secure courier, return receipt requested. Failure to properly comply with these requirements may be cause to require replacement of all or any part of the

cylinders and keys involved as deemed necessary at no additional cost to the City.

.6 Furnish one key control system complete with indexed door numbers, key codes, bittings, building numbers, room numbers, lock function, design, and finish. In addition, include model numbers, handing, design, and functions of exit devices and door closers. Transmit to the City by secure carrier, return receipt requested.

.7 Provide complete cross-index system, place keys on markers and hooks in the cabinet as determined by the finial key schedule. Provide one each key cabinet and hinged panel type cabinet for wall mounting as noted in detailed hardware schedule.

.2 Standard Keying With Exterior High-Security Cylinders

.1 Interior locks and cylinders shall be furnished in a new masterkey system.

.2 Exterior locks and cylinders to be high-security removable core cylinders with level-three side-bit milling to allow integration with existing standard key systems.

.3 Permanent cylinders to be factory-keyed, combinated in sets or subsets, master keyed or great grand master keyed, as directed by City. Permanent keys and cylinders shall be marked with the keyset symbol on all keyblanks for identification. Visual key control marks or codes will not include the actual key cuts.

3 Execution

3.1 EXAMINATION

.1 Ensure that doors and frames are properly prepared and reinforced to receive finish hardware prior to installation.

.2 Ensure that door frames and finished floor are sufficiently plumb and level to permit proper engagement and operation of hardware.

.3 Submit to Contract Administrator in writing a list of deficiencies determined as part of inspection required in 3.3.1 and 3.3.2, prior to installation of finished hardware.

3.2 INSTALLATION

.1 Install hardware to ANSI/DHI-A115.1G.

.2 Install hardware at mounting heights as specified in the manufacturer's templates or specific references in approved hardware schedule or approved elevation drawings. Where mounting height is not otherwise specified herein, install hardware at the following mounting heights:

.1 Locksets: 1015mm.

.2 Exit device: 1015mm.

.3 Push/Pull: 1065mm.

.4 Deadlock: 1200mm.

.3 Install hardware using only manufacturer supplied and approved fasteners in strict adherence with manufacturers published installation instructions.

.4 Ensure that all locksets / latchsets / deadlocks are of the correct hand before installation to ensure that the cylinder is in the correct position. Handing is part of installation procedure.

.5 Ensure that all exit devices are of the correct hand and adjust device cam for proper outside trim function prior to installation. Handing is part of installation procedure.

.6 Follow all manufactures installation instructions. Adjustment is inclusive of spring power, closing speed, latching speed and back-check at the time of installation.

.7 Delayed action door closers are to be adjusted to forty (40) second delay for handicapped accessibility and movement of materials. Time period to be approved by City.

.8 Install head seal prior to installation of parallel arm mounted door closers and push side mounted door stops/holders.

.9 Counter sink through bolt of door pull under push plate during installation.

.10 Mount all closers, automatic operators and hold-open devices with through bolts, as indicated in the finish hardware schedule.

.11 Where door stop contacts door pulls, mount stop to strike bottom of pull.

.12 Remove construction locks when directed by Contract Administrator ; install permanent cores and check operation of all locks.

.13 Other trades installing hardware must follow all manufacturer's instructions including door closer adjustment, handing of locksets as required, and degree of door swing.

.14 Hardware Distributor will include all labour to terminate secondary low voltage wire runs at all door control devices supplied by this section, including but not limited to; door operators, magnetic locks, push button code entry units (keypads), request to exit switches, electric strikes and any associated electrical equipment. Ensure system is tested and complete for City's use. Provide staff training for push button code system (keypads) including all programming function and maintenance.

.15 Hardware Distributor will instruct the installer as to how various newer or unusual items that are required to be installed for proper performance.

3.3 FIELD QUALITY CONTROL

.1 Hardware distributer to perform bi-monthly on-site inspections during hardware installation and provide inspection reports listing progress of work, unacceptable work and corrective measures. Repair or replace as directed by the Contract Administrator .

.2 Upon completion of hardware installation, arrange with the City and Contract Administrator demonstration and training in the proper operation, adjustment, and maintenance of all finish hardware supplied under this Contract.

.3 Before completion of the Work but after finish hardware installation has been completed, submit a certificate to the Contract Administrator stating that final inspection has been made and that all hardware has been checked for installation and operation by representatives of both the Hardware Supplier and the Hardware Distributor, and that operation and maintenance of all hardware has been fully demonstrated to the satisfaction of the City, and verified by Contract Administrator .

3.4 ADJUSTING AND CLEANING

.1 Check and make final adjustments to each operating item of hardware on each door to ensure proper operation and function.

.2 All hardware to be left clean and free of disfigurements.

.3 Check all locked doors against approved keying schedule.

3.5 PROTECTION

.1 Protect hardware from damage during construction period by removing and reinstalling or where necessary, using temporary hardware to maintain finish in new condition and maintain manufacturer's warranty.

3.6 HARDWARE SCHEDULE

.1 Refer to attached Hardware Schedule prepared by Hardware Consultant (To be provided at later date).

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Section includes supply and installation of glass and glazing materials.

1.3 PERFORMANCE REQUIREMENTS

.1 Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass as calculated in accordance with the Building Code and to withstand design pressures specified in applicable sections.

.2 Where glass extends from 1070 mm to floor, design lateral loads, in addition to other load requirements, in accordance with applicable codes.

.3 Unless otherwise specified, limit glass deflection to L/175 or flexure limit of glass with full recovery of glazing materials, whichever is less.

.4 Provide tempered, laminated, laminated-heat strengthened and heat soaked glass and related fittings and hardware in doors, side lites, screens, storefronts, glazed curtain walls, and glazed guard rails accordance with applicable codes and as indicated or scheduled.

.5 Unless otherwise specified or indicated, provide tempered glass where sill of glass is less than 300 mm above finished floor.

.6 Unless otherwise specified or indicated, provide laminated-heat strengthened and heat soaked glass where glass is a guard.

.7 Sealed Insulating Glass Units: Provide units free of the following characteristics:

.1 Appearance of condensation between panes.

.2 Obstruction of vision at unit perimeter.

.3 More than 10 percent measurable deterioration of thermal transmission or shading coefficient values.

.4 Chipping, cracking, or breakage of glass panes occurring due to manufacturing defects or under specified service conditions.

.5 Migration of edge spacer.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

.1 Coordinate with other work having a direct bearing on work of this Section.

.2 Coordinate adequate supports in hollow partitions for large mirrors with Installers of applicable Sections.

.3 Coordination of the Location of Tempering and Laminated Glass Stamps/Logos: Contractor is required to discuss and coordinate the location of the Tempering and Laminating stamps/ logos with the Contract Administrator at the time of shop drawing submission. This is to be reviewed and approved prior to the ordering of any glass.

1.5 SUBMITTALS FOR REIVEW

.1 Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

.2 Product Data on Glazing Sealant: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colours.

.3 Shop Drawings: For glass indicated to comply with performance requirements.

.1 Clearly indicate glass types, configurations, thicknesses, translucent finishes, treatments, coatings, gaskets, hardware and accessories.

.2 Indicate forces applied to connections at structure and analysis data.

.3 Apply signature and seal by a qualified professional structural engineer licensed in the Province where the Project is located.

.4 Samples:

.1 Submit two 300 x 300 mm samples for each type of glass specified.

.2 Glazing Accessory Samples: Submit samples of each type of glazing accessory. For structural glazing sealants, install 300 mm length of sealant between two edges of representative glass samples.

.5 Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated or scheduled.

1.6 SUBMITTALS FOR INFORMATION

.1 Manufacturer's Certificate: Certify that glass products conform to requirements.

.2 Qualifications Data: For installer. Include proof of adequate facilities and capacity to produce work.

.3 Professional Structural Engineer’s Letters of Assurance:

.1 Provide letters or completed prescribed forms, signed by the professional structural engineer used to perform inspections and design glass, stating that the glass indicated conforms to performance requirements and design criteria, and has been fabricated and installed in accordance with applicable code requirements.

.4 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentations to the following:

.1 Energy & Atmosphere

.1 Credit 1 - Optimize Energy Performance

.2 Materials & Resources:

.1 Credit 2 - Construction Waste Management: Divert 50% from Landfill

.2 MR Credit 4 - Recycled Content: 10% (post-consumer + ½ pre-consumer)

.3 MR Credit 5 - Regional Materials: 20% Extracted and Manufactured Regionally

.3 Indoor Environmental Quality

.1 IEQ Credit 4.1 - Low-Emitting Materials: Adhesives & Sealants

.2 IEQ Credit 4.2 - Low-Emitting Materials: Paints and Coating

.3 IEQ Credit 6.1 - Controllability of Systems – Lighting

.4 IEQ Credit 8.1 Daylight and Views: Daylight

.5 IEQ Credit 8.2 Daylight and Views: Views

.4 Innovation & Design Process

.1 ID Credit 1.1-1.4 - Innovation in Design

1.7 QUALITY ASSURANCE

.1 Perform Work in accordance with GANA (Glass Association of North America) Glazing Manual, and GANA Laminated Glazing Reference Manual, for design and fabrication of glazing and installation methods.

.2 Perform Work in accordance with Insulating Glass Manufacturer's Association of Canada (IGMAC) Glazing Guidelines for Sealed Insulating Glass Units, including requirements for guaranteed service life for manufacture and installation of sealed insulating glass units.

.3 Certify units to Insulating Glass Manufacturers Alliance (IGMA) program to ASTM E2190.

.4 Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: An insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

.5 Installer Qualifications: Company specializing in performing the work of this Section with minimum five (5) years' continuous documented experience on projects of similar scope and size, approved by the manufacturer, and a member in good standing of the OGMA.

.6 Labelling:

.1 Label glass, including mirrors, with manufacturer's labels identifying glass type and thickness.

.2 Safety Glazing: Permanently mark glazing with certification label of the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and the safety glazing standard with which glass complies.

.3 Insulating Glass Units: Permanently mark spacers, or at least one component lite, of units with appropriate certification label of IGMAC.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

.2 Minimize storage time of materials at site.

.3 Minimize handling. Install glass as soon as possible after delivery.

.4 Store glass at a constant temperature, vertically, blocked off the floor and in a designated clean, dry and dust-free and corrosive contaminant-free interior storage area with adequate air circulation.

.5 Protect glass from contact with contaminants.

1.9 WARRANTY

.1 Provide a ten (10) year manufacturer's insulated glass unit warranty to include coverage for:

.1 Sealed glass units from seal failure, interpane dusting or misting of any nature, and replacement of same.

.2 Delamination of laminated glass and replacement of same.

.3 Colour fading of interlayer and replacement of whole glass units.

.4 Reflective coating on mirrors and replacement of same.

.2 Installation of plastic films on glass shall not diminish coverage of warranties for glass.

2 Products

2.1 GLASS MATERIALS

.1 Tempered Safety Glass: CAN/CGSB-12.1 Type 2, Class B, thickness as indicated, heat treated using the horizontal tong free method, with roll-wave distortion parallel to bottom edge of glass as installed.

.2 Fire rated glass: Laminated ceramic fire-rated glass, ULC-listed to conform with CAN-ULC S104 & 106, impact-safety tested to ANSI Z97.1:

.1 Acceptable Products:

.1 Saint-Gobain Keralite Select Laminated by Vetrotech.

.2 Nippon Glass FireLite Plus by Technical Glass Products.

.3 Schott Pyran Platinum L by Glassopolis.

.3 Laminated Safety Glass: CAN/CGSB-12.1, Type 1, Class B, fabricated with overall thickness as indicated, with clear polyvinylbutyral interlayer between 2 plies of glass. Treat exposed edges of laminated glass susceptible to degradation by organic solvents and glazing compounds.

.4 Back Painted Glass: CAN/CGSB 12.9 spandrel glass, water based silicone, minimum 0.33 mm thick elastomeric solvent-free coating non-accessible surface, Opaci-Coat by ICD High Performance Coatings.

.1 Colour: Primary White.

.5 Bird Friendly Pattern: Ceramic bake solid coating on glass panel no. 1 surface to pattern below:

.1 White colour 6 mm diameter dots at 50 mm on center spacing, with 100% coverage of glass surface.

.6 Low-Emissivity (Low E) Coating: Coating deposited by vacuum deposition process after glass manufacture and heat treatment, Solarban 60 by Vitro Architectural Glass, or ClimaGuard 70 by Guardian Glass.

2.2 GLAZING ACCESSORIES

.1 Setting Blocks: Neoprene, EPDM or silicone, 80 to 90 Shore A durometer hardness tested to ASTM D2240, length of 25 mm for each square metre of glazing or minimum 100 mm x width of glazing rabbet space minus 1.5 mm x height to suit glazing method and pane weight and area. Maximum compression set to ASTM D395 and ASTM C864

.2 Spacers: Neoprene EPDM or silicone, 40 to 60 Shore A durometer hardness tested to ASTM D2240, minimum 75 mm long x one half the height of the glazing stop x thickness to suit application. Quantity and location in accordance with IGMAC standards and as recommended by the frame and glass manufacturer. Provide face shims when gunable materials or non-shimmed tapes are used. Provide anti-walk edge blocks or side shims in dry glazed frames to limit glass lateral movement

.3 Glazing Tape: Preformed butyl compound, UV resistant, self-adhering, coiled on release paper, service temperature range of minus 40 to plus 50 degrees C, colour as selected by Contract Administrator, minimum 3 mm thickness and as follows:

.1 Glass up to 2540 United Millimetres: 5 mm.

.2 Glass Units over 2540 United Millimetres: 6 mm.

.3 Double Glazed Units: 7 mm.

.4 Pre-Shimmed Glazing Tape: Pre-formed butyl tape, UV resistant, self-adhering, integral continuous serrated synthetic rubber shim and release paper, 10 to 15 Shore A durometer hardness, service temperature range of minus 54 to plus 104 degrees C, designed for 25 to 50 percent compression, colour as selected by Contract Administrator, minimum 3 mm thick.

.5 Glazing Wedges and Splines: Precision extruded neoprene or EPDM compound, UV resistant, 55 to 65 Shore A durometer hardness, designed for use with pre-shimmed glazing tape, sized to suit glazing channel retaining slot.

.6 Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

.7 Structural Silicone Glazing Sealant: Structural sealant as specified in Section 07 92 00 – Sealants.

2.3 SEALED INSULATING GLASS UNITS

.1 Fabricate sealed glass units through the Insulating Glass Manufacturers Association of Canada Certification Program to CAN/CGSB 12.8 or ASTM E2910. Sealed units shall bear IGMAC or IGCC/IGMA Certified Products List number and be properly identified.

.2 Sealant:

.1 Primary Seal: Polyisobutylene as recommended by glazing manufacturer to meet performance criteria.

.2 Secondary Seal: two part silicone or polysulfide as recommended by glazing manufacturer to meet performance criteria.

.3 Perimeter Seal shall consist of three components; a "Warm Edge" spacer; a primary polyisobutylene seal between spacer and glass sheets, and a secondary two-part silicone or polysulfide perimeter seal.

.4 Gas fill with Argon to manufacturer's specifications after completion of sealed unit fabrication.

2.4 GLAZING FILMS

.1 Anti Graffiti Films: Scratch resistant, clear, flexible, cast vinyl face and clear pressure sensitive adhesive back with release liner, Anti Graffiti 7 by 3M or 7 Mil Graffitigard by Solargard.

3 Execution

3.1 EXAMINATION

.1 Verify that openings for glazing are correctly sized and within tolerance.

.2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 PREPARATION

.1 Clean contact surfaces with solvent recommended for use by the sealant manufacturer, and wipe dry thoroughly.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

3.3 EXTERIOR GLAZING

.1 Aluminum Frames - Tape / Gaskets

.1 Cut glazing tape to length and set against permanent stops, level with sight line. Seal corners by butting tape and dabbing with sealant.

.2 Apply heel bead of sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapour seal.

.3 Place setting blocks at 1/4 points, with edge block maximum 150mm from corners.

.4 Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of light or glass unit.

.5 Install removable stops with gaskets inserted between glazing and applied stops.

.2 Wet Method -Sealant / Sealant

.1 Place setting blocks at 1/4 points and install glazing light or unit.

.2 Install removable stops with glazing centred in space by inserting spacer shims both sides at 600mm intervals, 6mm below sight line.

.3 Fill gaps between glazing and stops with sealant to depth of bite on glazing, maximum 10mm below sight line to ensure full contact with glazing and continue air and vapour seal.

.4 Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

.3 Structural Silicone Glazing

.1 Cut glazing tape to length and set against permanent stops, 6mm back from sight line. Seal corners by butting tape and dabbing with sealant.

.2 Place setting blocks at 1/4 points, with edge block maximum 150mm from corners.

.3 Rest glazing on setting blocks and push against tape with sufficient pressure to attain full contact at perimeter of light or glass unit.

.4 Apply heel bead of sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapour seal.

.5 Install backer rod and weather seal between glass unit edges.

.6 Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.4 INTERIOR GLAZING

.1 Wet Method - Sealant / Sealant

.1 Install glazing resting on setting blocks. Install applied stop and centre light by use of spacer shims at 600mm centres, 6mm below sight line.

.2 Locate and secure glazing light using glazers' clips.

.3 Fill gaps between glazing and stops with glazing sealant until flush with sight line. Tool surface to straight line.

.2 Steel Frames - Tape / Sealant

.1 Cut glazing tape to length and set against permanent stops, 3mm below sight line. Seal corners by butting tape and dabbing with sealant.

.2 Place setting blocks at 1/4 points, with edge block maximum 150mm from corners.

.3 Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of light or glass unit.

.4 Install removable stops with spacer strips inserted between glazing and applied stops below sight line. Place glazing tape on glazing light or unit with tape 6mm below sight line.

.5 Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, maximum 6mm below sight line.

.6 Apply cap bead of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.5 GLAZING FILM INSTALLATION

.1 Install plastic film in locations and to designs indicated on the drawings.

.2 Clean glass to receive film, thoroughly and let dry.

.3 Install plastic film in accordance with film manufacturer's instructions.

.4 Remove all air bubbles, creases or visible distortion.

.5 Fit tight to glass perimeter.

3.6 CLEANING & PROTECTION

.1 During installation, remove all corrosive or foreign materials or droppings resulting from work of this trade.

.2 Perform initial cleaning operation of all glass and mirrors upon completion of installation. Do not remove labels or protective films until time of final cleaning.

.3 After initial cleaning, mark large lites with an "X" by using removable plastic tape. Do not use masking tape. Do not mark heat absorbing or reflective glass units.

.4 Provide instructions for the proper method and materials to be used in the cleaning and maintenance of finished surfaces. Remove all remaining labels and protective films at time of final cleaning.

3.7 GLAZING SCHEDULE

.1 Type IG: Exterior “Triple” “Double” Glass Unit:

.1 Outer Glass Pane: 6 mm thick clear tempered glass, with bird friendly pattern on no. 1 surface and Low E coating on no. 2 surface.

.2 Air Space: 90% argon gas fill, with 12 mm, colour black, warm edge spacer seal.

.3 Middle Glass Pane: 6 mm thick clear tempered glass.

.4 Air Space: 90% argon gas fill, with 12 mm, colour black, warm edge spacer seal.

.5 Inner Glass Pane: 6 mm thick clear tempered glass.

.2 Type SP: Exterior “Triple” “Double” Spandrel Glass Unit:

.1 Outer Glass Pane: 6 mm thick clear tempered glass, with back painted coating on no. 2 surface.

.2 Air Space: 90% argon gas fill, with 12 mm, colour black, warm edge spacer seal.

.3 Middle Glass Pane: 6 mm thick clear tempered glass.

.4 Air Space: 90% argon gas fill, with 12 mm, colour black, warm edge spacer seal.

.5 Inner Glass Pane: 6 mm thick clear tempered glass.

.3 Type VG: Interior Single Glass:

.1 6 mm thick, clear tempered glass.

.4 Type FRG: Interior Single Fire Rated Glass:

.1 8 mm thick, laminated fire rated glass.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of fixed louvers, bird screens, blank-off panels and attachment brackets as shown on drawings, as specified and as required for complete and proper installation.

.2 Fixed louvers to be furnished include the following:

.1 Storm Resistant Louver

1.3 REFERENCES

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM B209, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate

.2 ASTM B211, Standard Specification for Aluminum and Aluminum Alloy Rolled or Cold Finished Bar, Rod, and Wire

.3 ASTM B221, Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

.4 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

.3 Canadian Standards Association (CSA):

.1 CAN/CSA-S157-05/S157.1-05, Strength Design in Aluminum / Commentary on CSA S157, Strength Design in Aluminum

.2 CAN/CSA-S136, North American Specification for the Design of Cold-Formed Steel Structural Members

.4 Architectural Aluminum Manufacturers Association (AAMA):

.1 AAMA 605.2, Voluntary Specification for High Performance Organic Coatings on Aluminum Extrusions and Panels

.2 AAMA 800, Voluntary Specifications and Test Methods for Sealants

.3 AAMA 2605 Superior Performing Organic Coatings on Aluminum Extrusions and Panels

.4 AAMA TIR Metal Curtain Wall Fasteners (2000 Addendum)

.5 Air Movement and Control Association International Inc. (AMCA):

.1 AMCA Standard 500-L, Laboratory Methods of Testing Louvers for Rating

.2 AMCA Publication 501, Application Manual for Louvers

.3 AMCA Publication 511, Certified Ratings Program - Product Rating Manual for Air Control Devices

1.4 IL ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate the Work of this Section with the installation of ductwork; Sequence work so that installation of louvers coincides with installation of HVAC materials without causing delay to the Work.

.2 Pre-Construction Conference: Arrange a site meeting attended by the Contractor, the Subcontractor, the Contract Administrator, materials supplier(s), and other relevant personal before commencement of work for this Section.

.1 Review methods and procedures related to installation, including manufacturer's written instructions;

.2 Examine substrate conditions for compliance with manufacturers installation requirements;

.3 Review temporary protection measures required during and after installation.

1.5 SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data:

.1 Air flow and water entrainment performance test results

.2 Material types and thickness

.2 Shop Drawings: Submit shop drawings showing the location, finished appearance and dimensions of each type of louver. Show all material, thicknesses, connections, fastenings, shapes and finishes.

.3 Coating Samples: Submit samples of factory applied coatings and finishes for Contract Administrator’s initial selection.

.4 Samples: Submit for approval 305mm (12") long sample lengths of each type of louver blade and frame extrusion prior to full scale production, showing finish colour.

.2 Information Submittals:

.1 Certification: Submit product test reports based on evaluation of comprehensive tests performed by a qualified testing agency for each type of louver required for this project.

.2 Performance Requirements: Provide AMCA test data as required to confirm that the louvers have the specified air and water performance characteristics.

.3 Acoustical Performance: Where applicable, submit test reports to confirm that the louvers meet the specified STC and Noise Reduction requirements.

.4 Structural Requirements: Design all materials to withstand wind load of 20 psf (955 Pa) and snow loads as required by the applicable building code, and recommended by the louver manufacturer.

.1 Ensure louver members deflect no more than L/180 of span between supports when subjected to wind load applied horizontally to louver face.

.5 Delegated Design Submittals: Furnish complete design calculations and details, fabrication and erection shop drawings and site review for fixed louvers, bearing the seal of a Professional Engineer registered in the Province of the Work, in accordance with applicable Building Code and Contract Documents.

.3 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentations to the following:

.1 Materials & Resources:

.1 MR Credit 4 - Recycled Content: 10% & 20% (post-consumer + ½ pre-consumer)

.2 MR Credit 5 - Regional Materials: 20% & 30% Extracted and Manufactured Regionally

.2 Indoor Environmental Quality

.1 IEQ Credit 4.1 - Low-Emitting Materials: Adhesives & Sealants

.2 IEQ Credit 4.2 - Low-Emitting Materials: Paints and Coating

1.6 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: Submit manufacturer's written instructions for cleaning solutions, materials and procedures, include name of original installer and contact information..

.1 Provide specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.

1.7 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Contract Administrator:

.1 Manufacturer / Supplier: Obtain materials from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties.

.2 Installers: Execute Work of this Section using qualified personnel skilled in installation of work of this Section, having a minimum of three (3) years proven experience of installations similar in material, design, and extent to that indicated for this Project.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Delivery: At the time of delivery, visually inspect all materials for damage. Note any damaged boxes, crates, or louver sections on the receiving ticket and immediately report to the shipping company and the material manufacturer.

.2 Storage: Store louver raised off the ground and cover with a weather proof flame resistant sheeting or tarpaulin.

.3 Handling:

.1 Material shall be handled in accordance with sound material handling practices and in such a way as to minimize racking.

.2 Louver sections may be hoisted by attaching straps to the jambs and lifting the section while it is in a vertical position.

.3 Louver sections should only be lifted and carried by the jambs. Heads, sills and blades are not to be used for lifting or hoisting louver sections.

1.9 SITE CONDITIONS

.1 Verify dimensions of actual opening by field measurements before fabrication and indicate measurements on Shop Drawings where fixed louvers are indicated to fit walls and other construction.

.2 Establish dimensions and proceed with fabricating fixed louvers where field measurements cannot be made without delaying the work; allow for trimming and fitting.

1.10 WARRANTY

.1 Warrant the work of this section in accordance with General Conditions but for a period of one (1) year and agree to repair or replace faulty materials or work which becomes evident during the warranty period without cost to the City and at the City's convenience.

.2 Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on aluminum louvers within the specified warranty period and agreeing to repair finish or replace louvers that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, colour fade, chalking, cracking, peeling, and loss of film integrity for a period of ten (10) years from date of Substantial Performance.

2 Products

2.1 MANUFACTURER

.1 Basis-of-Design products are named in this Section; additional manufacturers offering similar fixed metal louvers may be incorporated into the work provided they meet the performance requirements established by the named products.

.2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 McGill Architectural Products

.2 TenPlus Architectural Products Ltd.

.3 Construction Specialties

2.2 MATERIALS

.1 Aluminum Extrusions: ASTM B211, Aluminum Alloy 6063-T52.

.2 Aluminum Sheet: ASTM B209, Aluminum Alloy 6063-T52.

.3 Fastenings: Provide zinc plated steel or AISI Type 304 stainless steel for screws and fasteners.

.4 Structural Support: Designed and furnished by louver manufacturer to support wind load of 955 Pa (20 psf), unless otherwise specified.

2.3 STORM RESISTANT LOUVERS:

.1 178mm (7") deep fixed type, storm resistant aluminum louver, with 6063-T52 aluminum alloy extrusion, and as described in the following performance criteria:

.1 Certification: Louver AMCA tested, certified and licensed to bear the AMCA seal for the following:

.1 Air performance

.2 Water penetration

.3 Wind driven rain

.2 Extrusion Thickness:

.1 Head, Sill, Jambs and Mullions: Minimum 2mm (0.080") thick.

.2 Blades: Minimum 2mm (0.080") thick.

.3 Louver Type: Mullion or continuous line construction

.4 Blade Angle: 35º

.5 Free Area - 1220mm x 1220mm (4' x 4') unit: 0.75m² (8.03 sq.ft.)

.6 Percentage of Free Area: 50.3%

.7 Wind Driven Rain Water Penetration Data:

.1 Effectiveness Ratio: 99.8% Class "A" Rating)

.8 Basis of Design Product: Model R7355 Storm Resistant Drainable Louver by TenPlus Architectural Products Ltd.

.2 127mm (5") deep fixed type, storm resistant aluminum louver, with 6063-T52 aluminum alloy extrusion, and as described in the following performance criteria:

.1 Certification: Louver AMCA tested, certified and licensed to bear the AMCA seal for the following:

.1 Air performance

.2 Water penetration

.3 Wind driven rain

.2 Extrusion Thickness:

.1 Head, Sill, Jambs and Mullions: Minimum 2mm (0.080") thick.

.2 Blades: Minimum 1.77mm (0.070") thick.

.3 Louver Type: Mullion construction

.4 Blade Angle: 45º

.5 Free Area - 1220mm x 1220mm (4' x 4') unit: 0.70m² (7.54 sq.ft.)

.6 Percentage of Free Area: 47.1%

.7 Wind Driven Rain Water Penetration Data:

.1 Effectiveness Ratio: 99.8% (Class "A" Rating)

.8 Basis of Design Product: Model R5455 Storm Resistant Drainable Louver by TenPlus Architectural Products Ltd.

2.4 ACCESSORIES

.1 Sill Flashing: Provide sill flashing of same material and finish as adjacent louver, as approved by the Contract Administrator.

.2 Structural Support:

.1 Louver Support: Designed and furnished by louver manufacturer to support wind load of 955 Pa (20 psf), unless others specified.

.2 Support Angle: Louvers openings greater then 3m (10') high require horizontal girt at mid span, as indicated in Section 05 50 00 – Miscellaneous Metals.

.3 Insect Screens:

.1 Supply manufacturer's standard aluminum mesh insect screen, welded to aluminum frame. Removable screen frame to be independent to louver assembly, attaching to the interior face of the louver, providing continuous coverage.

.4 Blank-Off Panels:

.1 Non-Insulated Blank-off Panels:

.1 Facing Panels: 1mm (0.040") thick aluminum sheet blank-off panel.

.2 Finish:

.1 Exterior face sheet: Finished to match adjacent louver.

.2 Interior face sheet: Mill finish.

2.5 FABRICATION

.1 Fabricate as required for optimum performance with respect to water penetration, strength, durability and uniform appearance.

.2 Fabricate louvers to outside dimensions indicated, with allowance of 10mm (3/8") on each side for sealant joints. Coordinate size, location and placement of units, with installer, prior to fabrication.

.3 Fabricate louvers to minimize field adjustments, splicing, mechanical joints and field assembly of units. Assemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling.

.4 Clearly mark units for assembly and coordinated installation. Include vertical structural supports, where required.

.5 Provide vertical mullions of type and spacing indicated but not greater than 1524mm (5') o/c. Mechanically assemble louvers using stainless steel or zinc plated steel fasteners recommended by manufacturer.

.6 Provide supports, anchors and accessories required for a complete assembly.

2.6 FINISHES

.1 High Performance Organic Finish:

.1 2 Coat PVDF Coating: AA-C12 Chemical Finish, cleaned with inhibited chemicals; C40 Chemical Finish, conversion coating; R1x Organic Coating, manufacturer's standard 2 coat, thermo-cured system consisting of specially formulated inhibitive primer and fluoropolymer colour topcoat containing not less than 70% PVDF resin by weight; prepare, pre-treat, and apply coating to exposed metal surfaces in accordance with AAMA 2604 and with coating and resin manufacturers' written instructions.

.1 Colour: White, from the manufacturer's standard colour offering.

.2 Basis of Design Material: PPG Duranar by PPG Industries.

.2 Exposed Steel Finishing:

.1 Shop Primer for Ferrous Metal: Organic zinc rich primer, ready for finish painting by Section 09 90 00 – Painting.

3 Execution

3.1 EXAMINATION

.1 Verification of Conditions:

.1 Examine openings to receive work and surrounding adjacent surfaces for conditions affecting installation. Coordinate with related sections providing openings to ensure proper dimensions are maintained.

.2 Verify dimensions of supporting structure by accurate field measurements so that work will be accurately designed, fabricated and fitted to the structure.

.2 Notify Contractor in writing of any conditions that are not acceptable.

.3 Proceed with installation after verification and correction of surface conditions acceptable to manufacturer.

3.2 INSTALLATION

.1 Comply with manufacturer's instructions and recommendations for installation of the work, as shown on approved Shop Drawings.

.2 Anchor louvers to the building substructure as indicated on Shop Drawings and architectural drawings.

.3 Erection Tolerances:

.1 Maximum variation from plane or location shown on the approved shop drawings 3mm in 3048mm (1/8" in 10').

.2 Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line: 1.6mm (1/16").

.3 Erection tolerances shall prevail under both load and no load conditions.

.4 Cut and trim component parts during erection only with the approval of the manufacturer, and in accordance with the manufacturer' recommendations. Restore finish completely.

.5 Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.

.6 Set units level, plumb and true to line, with uniform, tight joints to adjacent work.

.7 Provide necessary fastenings, anchors, clip angles, sills and sill flashings required to complete the installation.

3.3 PROTECTION

.1 Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

3.4 CLEANING

.1 Progress Cleaning: Leave work area clean at the end of each work day, ensuring safe movement of passing pedestrians.

.2 Final Cleaning: At completion of installation, clean all surfaces so they are free of foreign matter using cleaners recommended by material manufacturer.

.3 Restore louvers and accessory components damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Contract Administrator, remove and replace damaged systems with new at no additional cost to the City.

.4 Waste Management: Co-ordinate recycling of waste materials and packaging at appropriate facility, diverting waste from landfill. Certified installer shall be responsible for ensuring waste management efforts are practiced.

END OF SECTION

1 General

1.1 GENRAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 RELATED DOCUMENTS

.1 Schedule of finishes applies to finishes located in other Divisions where applicable.

.2 Schedule includes Basis of Design finish and product selections.

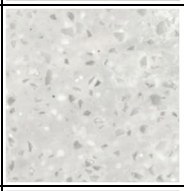
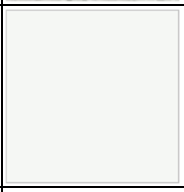
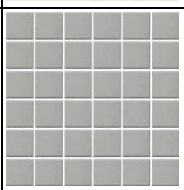
.1 Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

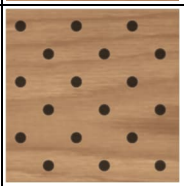
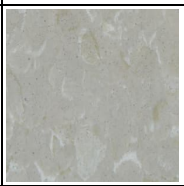
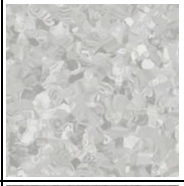
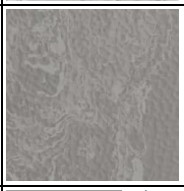
.3 Refer to room finish schedule, legends and Drawings for location of applied finishes schedule in this section.

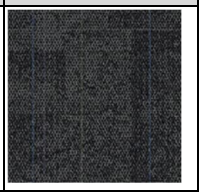
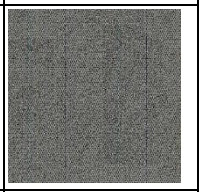
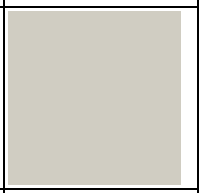
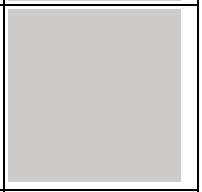
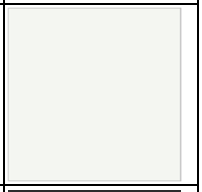
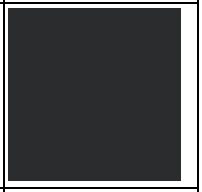
.4 Refer to technical specifications for submittal, quality and installation requirements for each product and finish listed in this schedule of finish.

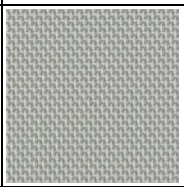
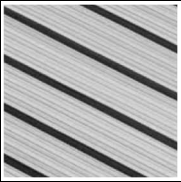
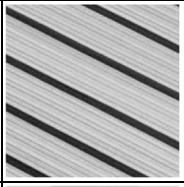
1.3 FINISHES SCHEDULE

Section	Code	Item/ Location	Description	Sample
06 20 00	PLAM-1	Plastic Laminate Kitchenettes, Lockers, Cabinets	Manufacturer: Formica Product: HGP Laminate Color: Natural Ash, Woodbrush Texture: Matte Thickness: 0.9 mm	
06 20 00	PLAM-2	Plastic Laminate Kitchenettes, Lockers	Manufacturer: Formica Product: HGP Laminate Color: Folkstone Texture: Matte Thickness: 0.9 mm	
06 20 00	PLAM-3	Plastic Laminate BOH Cabinetry Interiors	Manufacturer: Formica Product: HGP Laminate Color: Dover White #7197-58 Texture: Matte Finish Thickness: 0.9 mm	
06 20 00	PLAM-4	Plastic Laminate Various countertops	Manufacturer: Formica Product: CC Laminate Color: Surf Texture: Matte Thickness: 0.9 mm	
06 20 00	SST	Stainless Stee Sheet for Cabinet Base	Material: Stainless Steel Type 304 Finish: AISI No. 4 Thickness 1.0 mm	

Section	Code	Item/ Location	Description	Sample
06 61 16	SSF-1	Solid Surfacing Kitchen Areas	Manufacturer: Caesarstone Product: Quartz Stone Color: 405 Midday Size: 3050 mm x 1435 mm Thickness: 20 mm	
06 61 16	SSF-2	Solid Surfacing Washrooms	Manufacturer: Dupont Product: Corian Color: Arrowroot Thickness: 20mm	
07 46 19	MC-1	Sheet Metal Cladding	Manufacturer: Vicwest Product: AD300R Color: Cambridge White Thickness: 22 gauge Install Pattern: Vertical	
07 46 19	MC-2	Sheet Metal Cladding	Manufacturer: Vicwest Product: AD300 Color: White White Thickness: 22 gauge Install Pattern: Horizontal	
07 46 19	MC-3	Sheet Metal Cladding	Manufacturer: Vicwest Product: AD200 Color: White White Thickness: 22 gauge Install Pattern: Horizontal	
09 30 00	PCT-1	Porcelain Tile Washroom floor	Supplier: Centura Tile Product: New Avenue Size: 300mm x 600mm Color: Ash Texture: Matte Thickness: 9 mm	
09 30 00	PCT-2	Porcelain Tile Washroom wall	Supplier: Centura Tile Product: New Avenue Size: 300mm x 600mm Color: White Texture: Matte Thickness: 9 mm	
09 30 00	PCT-3	Mosaic Tile Shower Stall Floor	Supplier: Centura Tile Product: Classic/ Techno Size: 50mm x 50mm (300mm x 300mm sheet) Color: Stone Texture: Glazed Thickness: 6 mm	

Section	Code	Item/ Location	Description	Sample
09 51 13	AT-1	Acoustic Ceiling Tile Offices	Manufacturer: CGC Product: Mars Acoustical Ceiling Panels Profile: Square edge Texture: Fine Texture Color: White Size: 610mm x 1220mm x 19mm	
09 51 13	AT-2	Acoustic Ceiling Tile High Acoustical Rating Offices	Manufacturer: CGC Product: Mars High NRC/ CAC Panel Profile: Square edge Texture: Fine Texture Color: White Size: 610mm x 1220mm x 19mm	
09 54 23	LC-1	Linear Metal Ceiling Exterior soffit	Manufacturer: CGC Product: Paraline Plus Linear Color: Timbre – Golden Glow Oak 4198 Profile Size: 178mm x 25mm (7”x 1”) high	
09 54 23	LC-2	Linear Metal Ceiling Break room and Info centre	Manufacturer: CGC Product: Paraline Plus Linear Perforation: 5% Open, 45° circle, CD06305 Color: Timbre – Golden Glow Oak 4198 Acoustic: Acousticbond backing felt Size: 178mm x 25mm (7”x 1”) high	
09 65 00	VCT	Vinyl Composite Tile	Manufacturer: Tarkett Product: VCT II Color: 557 Shooting Star Size: 305mm x 305mm x 3mm	
09 65 00	VSDT	Vinyl Static Dissipative Tile	Manufacturer: Tarkett Product: iQ Granit SD Tile Color: Granit Grey 0948 Size: 610mm x 610mm x 2mm	
09 65 00	RBT	Rubber Tile	Manufacturer: Tarkett Product: Johnsonite Mesto Configuration Color: PS3 Noble Knight Size: 610mm x 610mm x 3mm	
09 65 00	RVB-1	Resilient Vinyl Base VCT and VSDT	Manufacturer: Tarkett Product: Johnsonite Traditional Vinyl 1/8” Color: TA5 Colonial Grey Size: 150mm x 3mm with toe cove	
09 65 00	RBB-1	Rubber Base for RBT	Manufacturer: Tarkett Product: Johnsonite Thermoset Rubber Color: TA5 Colonial Grey Size: 150mm x 3mm with toe cove	
09 65 00	RBB-2	Resilient Rubber Base for CPT	Manufacturer: Tarkett Product: Johnsonite Thermoset Rubber Color: VL4 Cool Metal Size: 100mm x 3mm toeless	

Section	Code	Item/ Location	Description	Sample
09 68 13	CPT-1	Carpet Tile Offices	Manufacturer: Interface Product: Open Air 404 Stria Color: 103276 Iron Construction: Tufted Textured Loop Size: 500mm x 500mm Thickness: 2.1mm	
09 68 13	CPT-2	Carpet Tile Quiet room	Manufacturer: Interface Product: Open Air 404 Stria Color: 10328 Flannel Construction: Tufted Textured Loop Size: 500mm x 500mm Thickness: 2.1mm	
09 90 00	PT-1	Paint General Wall Paint, Office walls	Manufacturer: Benjamine Moore Product: Aura Color: Rodeo 1534 LRV index: LRV59.84 Texture: Egg Shell	
09 90 00	PT-2	Paint Accent Paint Quiet Room, TV Room Offices	Manufacturer: Benjamine Moore Product: Aura Color: Cement Gray 2112-60 LRV index: LRV 59.96 Texture: Egg Shell	
09 90 00	PT-3	Paint Door, frame Paint	Manufacturer: Product: Color: LRV index: Texture:	
09 90 00	PT-4	Paint Drywall ceiling	Manufacturer: Benjamine Moore Product: Aura Color: Chantilly Lace 2121-70 LRV index: LRV 90.04 Texture: Flat	
09 90 00	PT-5	Paint Exposed ceiling	Manufacturer: Benjamine Moore Product: Aura Color: Black PM-9 LRV index: LRV 5.08 Texture: Flat	
10 21 33	URP-1	Urinal Partition	Manufacturer: ASI Global Partitions Product: Black Core Phenolic Color: Graphite 2150	
10 51 13	ML-1	Metal Locker	Manufacturer: ASI Storage Solutions Product: Traditional Collection Configuration Single Tier Color: White #29	

Section	Code	Item/ Location	Description	Sample
10 51 13	ML-2	Metal Locker	Manufacturer: ASI Storage Solutions Product: Traditional Collection Configuration Double Tier Color: White #29	
10 51 13	BN-1	Locker Room Bench	Manufacturer: ASI Storage Solution Products Bench Tops & Pedestals Bench Top: Black Core Phenolic White Ash 1841 Pedestal: Stainless Steel Trapezoidal Style	 
12 24 13	RS-1	Roller Shade	Manufacturer: MechoShade Product: EcoVeil 1550 Series Colour: Oyster 0706	
12 48 16	FGR-1	Foot Grille (with drain pan)	Manufacturer: K.N. Crowder Products FG-5 Material: Extruded Aluminium Texture: Serrated Finish: Clear Anodized	
12 48 16	FGR-2	Foot Grille (no drain pan)	Manufacturer: K.N. Crowder Products FG-5 Material: Extruded Aluminium Texture: Serrated Finish: Clear Anodized	
12 48 16	MWB	Metal Wall Base	Manufacturer: Schlüter Products DesignBase-SL-E Material: Stainless steel Size: 110 mm high	

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirement for supply and installation of components required for a complete wall and ceiling assemblies including non-loadbearing steel framing, board panels, and other installation accessories.

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.3 Canadian Standards Association (CSA):

.1 CSA S136, North American Specification for the Design of Cold-Formed Steel Structural Members.

.4 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-7.1, Lightweight Steel Wall Framing Components

.5 American Society for Testing and Materials International (ASTM):

.1 ASTM A641/A641M, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

.2 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.3 ASTM A792/A792M, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.4 ASTM A875/A875M, Specification for Steel Sheet, Zinc-5% Aluminum Alloy-coated by the Hot Dip Process.

.5 ASTM A1003/A1003M, Specification for Steel Sheet, Carbon, Metallic and Non-Metallic Coated for Cold Formed Framing Members.

.6 ASTM C11, Standard Terminology Relating to Gypsum and Related Building Materials.

.7 ASTM C473, Standard Test Methods for Physical Testing of Gypsum Panel Products.

.8 ASTM C475/C475M, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.9 ASTM C514, Standard Specifications for Nails for the Application of Gypsum Board.

.10 ASTM C645, Standard Specification for Nonstructural Steel Framing Members.

.11 ASTM C665, Standard Specification for Mineral-Fibre Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

.12 ASTM C754, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

.13 ASTM C834, Standard Specification for Latex Sealants.

.14 ASTM C840, Standard Specification for Application and Finishing of Gypsum Board.

.15 ASTM C841, Standard Specification for Installation of Interior Lathing and Furring.

.16 ASTM C954, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033" to 0.112" in Thickness.

.17 ASTM C955, Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases

.18 ASTM C1002, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.19 ASTM C1047, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

.20 ASTM C1177/C1177M, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.21 ASTM C1178/C1178M, Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.

.22 ASTM C1186, Standard Specification for Flat Fiber-Cement Sheets.

.23 ASTM C1278/C1278M, Standard Specification for Fiber-Reinforced Gypsum Panel.

.24 ASTM C1325, Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units

.25 ASTM C1396/C1396M, Standard Specification for Gypsum Board.

.26 ASTM C1629/C1629M, Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.

.27 ASTM C1658/C1658M, Standard Specification for Glass Mat Gypsum Panels.

.28 ASTM D3273, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

.29 ASTM D3274, Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation.

.30 ASTM D3678, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Interior-Profile Extrusions.

.6 Gypsum Association (GA):

.1 GA-214, Recommended Levels of Gypsum Board Finish.

.2 GA-216, Application and Finishing of Gypsum Board.

.3 GA-231, Assessing Water Damage to Gypsum Board.

.4 GA-238, Guidelines for the Prevention of Mold Growth on Gypsum Board.

1.4 DESIGN CRITERIA

.1 Where specified deflection limits and loading are exceeded, or where span is 3000 mm or longer, provide metal framing in accordance with Section 05 40 00 – Cold Formed Metal Framing, 05 41 00 – Structural Metal Stud Framing and CSA-S136, Cold Formed Steel Structural Members.

.2 Lateral loading, Typical Partitions: Design and install gypsum board components so that the completed partition will withstand a minimum inward and outward pressure of 240 Pa normal to the plane of the wall.

.3 Loading Criteria, Special Partitions: Design and install gypsum board components so that the completed system will withstand the minimum inward and outward pressure of not less than 480 Pa normal to the plane of the wall. This criterion shall apply to the following areas:

.1 Partitions surrounding stairs.

.2 Partitions surrounding plenum and air shafts.

.3 Partitions surrounding atriums.

.4 Partitions Surrounding Elevators Shafts.

.4 Design and install elevator gypsum shaftwall enclosure components so that the completed system will withstand the minimum inward and outward air pressure recommended by the elevator manufacturer, but in no case less than 720 Pa without failing and while maintaining an airtight and smoketight seal. Apply design loads transiently and cyclically under inservice conditions for maximum heights of partitions indicated.

.5 Deflection Criteria: Limit metal framing systems deflection under load to the following:

.1 Deflection, Support Framing Gypsum Board Partitions: Deflection of support framing for gypsum board partition systems shall be limited to L/240 of the span in height, except as otherwise shown or specified.

.1 In areas where room side finish is veneer plaster or ceramic tile, deflection of partitions shall be limited to L/360 of the span in height.

.2 Deflection, Support Framing Gypsum Board Ceilings: Gypsum board interior suspended ceilings, and partitions supporting tile, shall be designed for deflection not to exceed L/360 of the distance between supports

.3 Deflection, Support Framing Shaftwall Systems: Deflection of shaftwall systems shall be limited to L/240 of the span in height.

.1 In areas where room side finish is veneer plaster or ceramic tile, deflection of shaftwall systems shall be limited to L/360 of the span in height.

.6 Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ULC or similar UL listed design assemblies acceptable to authorities having jurisdiction.

.7 STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

.8 Design Modifications: Make design modifications only as may be necessary to meet performance requirements and coordinate the Work. Variations in details and materials which do not adversely affect appearance, durability or strength shall be submitted to the Contract Administrator for review.

1.5 QUALITY ASSURANCE

.1 Contractor executing work of this Section shall have a minimum of five (5) years continuous Canadian experience in successful installation of work of type and quality shown and specified. Submit proof of experience upon Contract Administrator's request.

.2 Perform Work in accordance with ASTM C840, GA-214, GA-216 and GA-600.

.3 Handling Gypsum Board: Comply with GA-801.

1.6 SUBMITTALS

.1 Shop Drawings: Submit shop drawings showing the design, construction and relevant details of furring, enclosures and partitions which require a fire rating.

.2 Product Data: Submit manufacturer's current technical literature for each component.

.3 Samples: Supply for Contract Administrator's review, if requested, samples of the following:

.1 Board: Submit sample of each panel product specified, 150mm (6") square.

.2 Trim: Submit sample of each type of trim specified, 305mm (12") long.

.3 Texture: Submit sample, 305mm (12") square, of textured coated gypsum board.

.4 Quality Assurance Submittals:

.1 Design Data, Test Reports: Provide manufacturer's test reports indicating product compliance with indicated requirements.

.2 Manufacturer's Instructions: Provide manufacturer's written installation instructions.

.5 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentation in accordance to the following:

.1 Materials & Resources:

.1 MR Credit 4 - Recycled Content: 10% (post-consumer + ½ pre-consumer)

.2 MR Credit 5 - Regional Materials: 20% Extracted and Manufactured Regionally

.2 Indoor Environmental Quality:

.1 EQ Credit 4.1 - Low-Emitting Materials: Adhesives & Sealants

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, enclosed, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store material in original, undamaged containers or wrappings with manufacturer's seals and labels intact, in accordance with GA-238 and manufacturer's recommendations.

.4 Protect bagged products from excessive moisture or wetting. Store metal component sections in crates to prevent damage to material. Do not use bent or deformed material.

1.8 PROJECT CONDITIONS

.1 Establish and maintain environmental conditions for application and finishing gypsum wallboard to comply with ASTM C 840 and in accordance with manufacturer's written instructions.

.2 In cold weather (outdoor temperatures less than 13 °C), controlled heat in the range of 13 °C to 21 °C must be provided. This heat must be maintained both day and night, 24 hours before, during, and after entire gypsum board joint finishing and until the permanent heating system is in operation or the building is occupied. Minimum temperature of 10 °C shall be maintained during gypsum board application.

.3 Ventilate building spaces to remove excess moisture and humidity during the drying process. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

2 Products

2.1 MATERIALS – WALLBOARD

.1 Standard Gypsum Wallboard: Conforming to ASTM C1396, paper faced, tapered edges, 1220mm (48") wide sheets of maximum practical lengths to minimize end joints, 12.7mm (1/2") thick.

.1 Easi-Lite by CertainTeed Canada.

.2 ToughRock Lite-Weight by Georgia-Pacific Canada.

.3 Sheetrock Ultralight by CGC Inc.

.2 Fire-Rated Gypsum Board: Conforming to ASTM C1396, fire resistant, paper faced, tapered edges, 1220mm (48") wide sheets of maximum practical lengths to minimize end joints, 16mm (5/8") thick.

.1 Type X Drywall by CertainTeed Canada.

.2 ToughRock Fireguard X by Georgia-Pacific Canada.

.3 Sheetrock Firecode X by CGC Inc.

.3 Abuse Resistant Gypsum Board: Conforming to ASTM 1629, fire resistant, tapered edges, paper faced, 1220mm (48") wide x 2440mm (96") length sheets, 15.9mm (5/8") thick, fire resistant gypsum core with glass fibre reinforced.

.1 Extreme Abuse by CertainTeed Canada.

.2 Sheetrock AR Firecode X Panel by CGC Inc.

.3 Goldbond XP Hi Abuse by National Gypsum.

.4 Moisture and Mould Resistant Board: Conforming to ASTM C1178, fire resistant, squared edges, fiberglass mat faced, 1220mm (48") wide x 2440mm (96") length sheet.

.1 GlasRoc Tile Backer by CertainTeed Canada.

.2 DensShield Tile Backer by Georgia-Pacific Canada.

.3 Durock Glass-Mat Tile Backerboard by CGC Inc.

.5 Gypsum Ceiling Board: Sag resistant, conforming to ASTM C1396, tapered edges, 1220mm (48") wide sheets of maximum practical lengths to minimize end joints, 12.7mm (1/2") thick.

.1 Easi-Lite Lightweight Interior Ceiling Gypsum Board by CertainTeed Canada.

.2 ToughRock Span 24 Lite-Weight Ceiling Board by Georgia-Pacific Canada.

.3 Sheetrock Ultralight Sag Resistant Interior Ceiling Board by CGC Inc.

.6 Exterior Gypsum Soffit Board: Conforming to ASTM C1396, fire resistant, tapered edges, paper faced, 1220mm (48") wide panels of maximum practical lengths to minimize end joints, 15.9mm (5/8") thick.

.1 Exterior Soffit Type X and Type C by CertainTeed Canada.

.2 ToughRock Fireguard C Soffit Board by Georgia-Pacific Canada.

.7 Exterior Gypsum Sheathing: Conforming to ASTM C1177/C1177M, fire resistant, squared edges, fiberglass mat faced, 1220mm (48") wide panels of maximum practical lengths to minimize end joints, 15.9mm (5/8") thick, with moisture resistant core.

.1 GlasRoc Sheathing by CertainTeed Canada.

.2 DensGlass Sheathing by Georgia-Pacific Canada.

.3 Securock Glass-Mat Sheathing by CGC Inc.

.8 Cement Board: Conforming to ASTM C1325, protected guarded edges, portland cement board, with meshed surface, 1220mm (48") wide x 2440mm (96") length sheets, 12.7mm (1/2") thick.

.1 Durock Cement Board by CGC Inc.

.2 Permabase Cement Board by National Gypsum.

2.2 MATERIALS - STEEL FRAMING

.1 Non-Loadbearing Steel Framing:

.1 General:

.1 Steel sheet components shall comply with ASTM C645 requirements for metal, unless otherwise indicated.

.2 Steel for non-loadbearing members shall have metallic coats that conform to ASTM A653M or ASTM A792M with minimum metallic coating weighs (mass) of Z275 (G90) and AZM180 (AZ60) respectively.

.3 Framing members shall comply with the CAN/CSA S136 - North American Specification for the Design of Cold Formed Steel Structural Members, for conditions indicated.

.2 Metal Studs:

.1 Minimum 0.46 mm (25 gauge), screwable with crimped web and returned flange. Provide knockout openings in web at 150 mm (6") O.C. to accommodate (if required) horizontal mechanical and electrical service lines, and bracing. Widths as indicated on drawings. Provide structural studs where indicated.

.2 Framing behind all fire resistant gypsum board shall be minimum 0.8 mm (20 gauge).

.3 Framing behind all abuse resistant gypsum board shall be minimum 0.8 mm (20 gauge).

.4 Where metal stud framing forms walls are to be thermally insulated as indicated on drawings, provide metal studs with integrated fastening system for glass fibre/mineral fibre insulation.

.5 Provide special shapes indicated on drawings as part of steel stud/drywall assemblies.

.3 Floor and Ceiling Partition Track:

.1 Made from galvanized sheet steel, minimum 0.46 mm (25 gauge), with minimum 30mm (1-3/16") legs, top track having longer legs were required to compensate for deflection of structure above. Width to suit metal studs.

.4 Furring Members:

.1 Hat-shaped, rigid furring channels shall comply with the ASTM C645 and shall have a minimum base steel thickness of 0.46 mm (25 gauge) and a minimum depth of 22 mm (7/8") the minimum width of furring attachment flanges shall be 13 mm (1/2").

.2 Resilient furring channels designed to reduce sound transmission shall have a minimum base steel thickness of 0.46 mm (25 gauge) and have a minimum depth of 13 mm (1/2").

.3 Furring members shall be used for furring out any surface for application of gypsum wallboard finish and for secondary furring member in suspended ceilings/soffits.

.4 All furring members shall be hot-dipped galvanized.

.5 Drywall Grid Suspension for Ceilings: Conforming to ASTM C645 and ASTM C754, direct hung system composed of main beams and cross furring members that interlock and as follows:

.1 Acceptable Product System:

.1 660-C Stab Drywall Grid Suspension System by Rockfon.

.2 Flat Ceiling Drywall Suspension System by USG Ceiling.

.3 1-1/2” Drywall Suspension System by Certainteed.

.4 Drywall Grid System by Armstrong Ceiling.

2.3 ACOUSTIC MATERIALS

.1 Acoustic Insulation: Refer to Section 07 21 00 for requirement.

.2 Acoustic Sealant: Refer to Section 07 92 00 – Sealants for requirement.

2.4 ACCESSORIES

.1 Concrete Anchors:

.1 Self-drilling tie wire anchors, "Red-Head No. T-32" by Phillips Drill Company, Division of ITT Industries of Canada Ltd., or approved equal.

.2 Concrete Inserts:

.1 Hot-dip galvanized "turtle back" type concrete inserts to suit conditions as approved by Contract Administrator, by Acrow-Richmond National Concrete Accessories, Division of Premetalco Inc., or approved equal.

.3 Gypsum Wallboard Accessories:

.1 In general, gypsum wallboard accessories shall conform to ASTM C1047.

.2 Corner Beads:

.1 Made from galvanized steel sheet conforming to ASTM A653, minimum 0.0179" (25 gauge). Minimum width of flanges 28mm for 13mm (1-1/8" for 1/2") thick wallboard and 32mm for 16mm (1-1/4" for 5/8") thick wallboard.

.3 Casing Beads:

.1 Made from galvanized steel sheet conforming to ASTM A653, minimum 30 gauge, U-shaped designed for finishing with joint compound.

.4 Control Joints:

.1 Made from galvanized sheet steel conforming to ASTM A653, minimum 0.0179" (25 gauge), or roll-formed zinc-alloy to resist corrosion, with expansion joint material perforated flanges.

.1 'Zinc Control Joint No. 093' by CGC Inc.

.2 or approved equal.

.5 Reveals:

.1 Galvanized sheet steel conforming to ASTM A653, minimum 0.0179" (25 gauge), in profiles as indicated on drawings.

.4 Wallboard Screws:

.1 Corrosion resistant, self-drilling, self-tapping gypsum wallboard screws conforming to ASTM C1002 (Type S) and ASTM C954 (Type S-12), 25mm (1") long No. 6 for single layer application, 41mm (1-5/8") long No. 7 for double layer application.

.2 At fire rated construction, type and size of wallboard screw shall be same as used in fire-rating test.

.5 Joint Compound for Interior Gypsum Board:

.1 Conforming to ASTM C475 and as recommended by gypsum wallboard, fire-rated gypsum wallboard and exterior wallboard manufacturers to suit conditions.

.6 Exterior Sheathing Joint-And-Penetration Treatment Materials:

.1 Silicone Emulsion Sealant: Meeting ASTM C920, Type S, Grade NS, compatible with glass fiber mesh tape and for treating joints and covering exposed fasteners.

.2 Glass-Fiber Mesh Tape: Self-adhering glass-fiber tape, minimum 50 mm (2") wide, 390 x 390 or 390 x 780 threads/ m (10 x 10 or 10 x 20 threads/ inch), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

.7 Joint Compound for Abuse-Resistant Panels:

.1 ToughRock™ Sandable Joint Compound, by Georgia-Pacific.

.2 Durabond/Sheetrock Setting-Type Joint Compound, by CGC Canada Inc.

.3 M2Tech 90 Moisture and Mould Resistant Setting Compound, by CertainTeed.

.8 Resilient Sponge Tape:

.1 Closed cell neoprene sponge type tape with self-sticking adhesive on one side. Permastik 122X by Jacobs and Thompson Ltd., or foamed vinyl type tape, Arnofoam by Arno Adhesive Tape Incorporated.

.9 Adhesive:

.1 Conforming to CGSB 71-GP-25M, and as recommended by manufacturer and compatible with contacted surfaces.

.10 Bituminous Paint: Acid and alkali resistant bituminous isolation coating.

.11 Butyl Tape: Extruded, High grade macro-polyisobutylene tape of width and shore hardness to suit conditions.

.12 Building Paper: No.15 asphalt saturated, organic felt in accordance with CSA A123.3.

3 Execution

3.1 EXAMINATION

.1 Examine gypsum wallboard panels for damage and existence of mould. Install only undamaged panels.

.2 Examine gypsum wallboard in accordance with GA-231 for water damage.

.3 Examine areas and substrates, with installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

.4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

.2 Coordinate installation of gypsum board suspension systems with installation of acoustical ceiling tiles (ACT) suspension systems. Where gypsum board suspension systems abut ACT systems, ensure that ceiling tiles grid fit into gypsum grid without affecting overall design and appearance.

.3 Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION - GENERAL

.1 Conform to ASTM C840, except as otherwise specified herein. Co-operate with mechanical, electrical and other trades to accommodate fixtures, fittings and other items in wallboard areas.

.2 Review extent of temporary heat provided. Carry out the work of this Section only when temperature is maintained and controlled in the range of 13 deg. C to 21 deg. C for at least 24-hours before installing gypsum wallboard and is maintained or can be maintained until joint compound and adhesives are dried or cured.

.3 Metal studs in partitions and bulkheads are to be continuous to underside of steel deck, except where noted otherwise on drawings. Continue framing around ducts penetrating partitions above ceiling.

.4 Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

.5 Install bracing at terminations in assemblies.

.6 Do not bridge building control and expansion joints with non-loadbearing steel framing members. Frame both sides of joints independently.

.7 Bring gypsum board into contact, but do not force into place.

3.4 STUD PARTITIONS

.1 Install studs in accordance with ASTM C754, GA-216, GA-600, and manufacturer's written instructions.

.2 Isolate contact surfaces to prevent electrolysis due to metal contact with masonry, concrete or dissimilar metal surfaces. Use bituminous paint, building paper, butyl tape or other approved means.

.3 Provide continuous dampproof course to underside of floor track.

.4 Install studs so flanges within framing system point in same direction.

.5 Provide accurately aligned partition tracks at top and bottom of partitions. Secure at 610 mm (24") O.C. and 50 mm (2") from each end.

.6 Erect studs vertically in partition tracks at 406 mm (16”) or 610 mm (24") O.C. maximum as required, and not more than 50 mm (2") from abutting walls, openings and each side of corners.

.7 Install cut to length intermediate vertical studs, in same manner and spacing as wall studs, over door frames and above and below other openings.

.8 Door Openings:

.1 Extend studs on each side of openings from floor to ceiling or structure above, whichever is indicated.

.2 Install cut to length piece of runner horizontally over door frames.

.3 Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

.4 Install two (2) studs at each jamb, unless otherwise indicated.

.5 Install cripple studs at head adjacent to each jamb stud, with a minimum 13 mm (1/2") clearance from jamb stud to allow for installation of control joint in finished assembly.

.9 Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

.10 Fire-Resistance Rated Partitions: Install framing to comply with fire-resistance rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

.11 Where studs extend over 3658 mm (12') in height provide internal horizontal bridging spaced approximately 1220 mm (4') O.C. vertically and provide double studs at each side of door frames.

.12 Size, brace and reinforce studs as necessary to provide sturdy, rigid partitions to heights and lengths required.

.13 Design bridging to prevent member rotation and member translation perpendicular to the minor axis. Provide for secondary stress affects due to torsion between lines of bridging. Maximum bridging spacing to be 1220 mm (48") O.C.

.14 Do not use wallboard to restrain member rotation and translation perpendicular to the minor axis.

.15 Securely anchor framing to building structure making allowance for deflection of structure above with relief joint to avoid transmission of structural loads to partitions.

.16 Where horizontal runs of service lines are to be installed, arrange with applicable trades to have lines installed prior to wallboard application.

.17 Z-Furring Members:

.1 Erect insulation, as specified in Section 07 21 00, Building Insulation and Vapour Barriers, vertically and hold in place with Z-furring members.

.2 Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or power-driven fasteners spaced 610 mm (24") O.C.

.3 At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 305 mm (12") from corner and cut insulation to fit.

.18 Install each framing member so fastening surfaces vary not more than 3 mm over 305 mm (1/8" over 12') from the plane formed by face of adjacent framing.

.19 Ensure close contact of surfaces. Surfaces with depression shall be built up by Contractor, or high points ground down, otherwise effectively caulk the wall perimeter to retard passage of sound waves. Provide acoustic sealant or sponge tape at junction of sound resistant walls and all other walls.

3.5 CEILING FURRING

.1 Install in accordance with ASTM C754, GA-216 and manufacturer's written instructions.

.2 Install suspension system components in sizes and spacings indicated on drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

.3 Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

.4 Hangers:

.1 Hangers for suspended gypsum wallboard ceiling, bulkheads and duct furring shall support the grillage independent of walls, columns, pipes, ducts, conduit and similar components.

.2 Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

.3 Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.

.4 Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

.1 Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

.5 Wire Hangers: Secure by looping and wire tying, either directly to structure or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

.6 Do not attach hanger to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.

.7 Powder actuated fasteners are not approved.

.8 Do not attach hangers to or through steel deck. Attach hangers to steel joists. Where joist spacing is not suitable and where ducts and other equipment interfere, provide adequate cross channels between joists and securely wire tie in position for support of hangers.

.9 Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.

.10 Do not connect or suspend steel framing from ducts, pipes, or conduit.

.11 Recessed ceiling fixtures which exert a load in excess of 49 kg/m^2 (10 lbs/ft^2) shall be suspended independent of ceiling furring for gypsum wallboard application.

.12 Prior to installation of suspension system confirm that ceiling heights called for on room finish schedules and drawings can be maintained and that all recess lighting can be accommodated and shall not interfere with piping, ductwork and the like.

.13 Space hangers at maximum 1220 mm (4') O.C. along the runner channels and not more than 150 mm (6") from the ends to support weight of ceiling and superimposed loads such as lighting fixtures, diffusers and grilles.

.14 Where ducts are large or where combination of ducts, or combination of ducts and other items interfere so that hanger spacing exceeds 1220 mm (4'), increase size of main runner channels and hangers accordingly to sustain increased loading and span.

.15 For fire-resistant rated assemblies, wire tie furring channels to supports.

.16 Install suspension systems that are level to within 3 mm (1/8") measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

.5 Carrying Channels:

.1 Space carrying channels at maximum 1220 mm (4') O.C. and not more than 150 mm (6") from boundary walls, interruptions of continuity and changes in direction.

.2 Run channels at right angles to structural framing members where splices are necessary, lap members at least 200 mm (8") and wire each end with minimum double strand of tie wire. Avoid clustering or lining up splices.

.3 Attach channels to rod hangers by bending hanger sharply under bottom of flange of runner and securely wire in place with a saddle tie.

.6 Cross Furring:

.1 Erect furring channels at right angles to carrying channels.

.2 Space furring channels at 610 mm (24") O.C. and not more than 150 mm (6") from boundary walls, interruptions in ceiling continuity and change in direction.

.3 Secure furring channels to each support with a double strand of tie wire or with clip approved by manufacturer of furring components. Splice joints by nesting and tying channels together.

.4 The wallboard furring channels shall be level to a maximum tolerance of 3 mm over 3658 mm (1/8" over 12') non-cumulative.

3.6 BOARD INSTALLATION – GENERAL

.1 Install gypsum board in accordance with ASTM C840, GA-216 and GA-600, and manufacturer's instructions.

.2 Vertically, with edges and ends occurring over firm bearing. Erect single layer gypsum board in non-fire rated partitions in most economical direction, with ends and edges occurring over firm bearing.

.3 Erect single layer fire rated gypsum board

.4 Use screws when fastening gypsum board to metal furring or framing.

.5 Double Layer Applications: Unless otherwise required for fire resistance ratings, install double layer gypsum board as follows:

.1 Apply gypsum board for first layer, placed perpendicular to framing or furring members. Use fire rated gypsum backing board for fire rated partitions and ceilings.

.2 Place second layer with fasteners perpendicular to first layer. Offset joints of second layer from joints of first layer.

.6 Place control joints consistent with lines of building spaces as indicated. Where not indicated install as directed at maximum 9 m (30’-0”) spacing and as specified in this section. Construct joints using back-to-back casing beads filled with a low modulus sealant capable of flexible joint movement. Maintain fire-resistance rating of wall assemblies.

.7 Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials and as indicated

3.7 BOARD INSTALLATION - EXTERIOR GYPSUM SHEATHING (SGB)

.1 Install where exterior gypsum sheathing is indicated or scheduled on steel stud framing.

.2 Install exterior gypsum sheathing in accordance GA-253 Application of Gypsum Sheathing, ASTM C1280 Standard Specification for Application of Gypsum Sheathing as well as manufacturer's printed instructions. Apply boards horizontally and fasten to framing at maximum 200 mm o.c.

.1 Make vertical ends and edge joints over the centers of framing members and offset end joints a minimum of one framing bay between adjacent rows of sheathing panels.

.2 Seal Joints and Fastener Heads: Apply sealant and specified tape to board and perimeter joints and around penetrations, in accordance with wall sheathing manufacturer’s instructions. Seal fastener heads with sealant.

3.8 BOARD INSTALLATION - CEMENT BOARD

.1 Fabricate and pre-cut cement board to required sizes and with necessary cutouts.

.2 Install cement board with edges centred on steel framing and joints staggered in adjacent rows. Fit ends and edges closely but do not force together.

.3 Install cement board fasteners at 150 mm (6") o.c. with perimeter fasteners between 10 mm to 16 mm (3/8" to 5/8") from ends and edges.

.4 Install cement board joint filler in accordance with cement board manufacturer's directions to produce watertight, filled joints without voids, cracks and excess joint filler.

3.9 ACOUSTIC ACCESSORIES INSTALLATION

.1 Install resilient furring channels horizontally at maximum 600 on centre. Locate joints over framing members. Install with fasting flange at the bottom.

.2 Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.

.1 Conform to ASTM C919 and with insulation manufacturer's instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

.3 Install acoustic sealant at gypsum board partition perimeters, in accordance with Section 07 92 00 – Sealants, at:

.1 Metal Framing: Two beads. Alternatively, install two continuous strips of acoustical separation tape.

.2 Face Layer. Seal with 10 mm bead.

.3 Seal all penetrations of partitions by conduit, pipe, duct work, rough-in boxes, and cables where Acoustic Sheet Putty Pads are specified and required for Wall Type STC Rating.

.4 Install Acoustic Putty Pads at all penetrations of partitions by conduit, pipe, duct work, rough-in boxes, and cables for partitions with STC ratings of 52 or greater.

3.10 FIRE RESISTANT ASSEMBLIES

.1 Fire resistance rating of gypsum board assemblies and framing shall be as called for on drawings or schedules, and as required to conform with applicable codes and requirements of authorities having jurisdiction.

.2 Appropriate ULC designs as listed in current ULC list of equipment and materials, Volume II, Building Construction, shall be placed when applicable. Extend partitions full height through ceiling space unless otherwise noted on drawings.

.3 Vertical bulkheads in ceiling spaces over fire rated glazed partitions, doors and the like shall have same fire rating as the door or partition over which they occur. All such bulkheads shall be of drywall construction unless otherwise noted.

.4 Use fire rated gypsum board as specified.

.5 Where lighting fixtures, diffusers, and the like are recessed into fire rated ceilings or bulkheads, provide enclosure to maintain required fire rating. Form removable panel to give access to fixture outlet box.

.6 Where fire hose cabinets or other fixtures or equipment are recessed in fire rated walls or partitions, provide drywall enclosure or backing to maintain required fire rating, unless otherwise detailed.

3.11 CONTROL JOINTS

.1 Install control joints using metal control joint strip as specified where:

.1 A partition, furring or column fireproofing abuts a structural element, dissimilar wall or partition assembly, or other vertical penetration, or ceiling.

.2 A ceiling or soffit abuts a structural element, dissimilar wall or partition assembly or other vertical penetrations.

.3 Wings of "L", "U" and "T"-shaped ceiling/soffit areas are joined;

.4 Construction changes within the plane of the partition or ceiling or soffit.

.5 Partition, restrained ceiling or furring run exceeds 9144mm (30').

.6 Unrestrained ceiling dimensions exceed 15240mm (50') in either direction.

.7 Expansion or control joints occur in the base exterior wall.

.8 Wallboard is installed over masonry control joints.

.9 And elsewhere as indicated on the drawings.

.2 Install in accordance with manufacturer's instructions. Where application is on furring members and double furring members at control joints, place one furring member on each side of the control joint.

3.12 BULKHEADS

.1 Fur out bulkheads in areas indicated and as required to conceal mechanical, electrical or other services in rooms where drywall finishes are scheduled, and elsewhere if called for on drawings.

.2 Ensure hangers are installed as to prevent splaying.

3.13 PRESSED STEEL (HOLLOW METAL) FRAMES

.1 Install pressed steel (hollow metal) frames where they occur in gypsum wallboard partitions.

.2 Anchor frames securely to studs using a minimum of three (3) anchors per jamb for jambs up to 2134mm (7') high and minimum of four (4) anchors per jamb for jambs over 2134mm (7') high.

3.14 THERMAL BREAK

.1 Install self-sticking resilient sponge tape at edges of wallboard in contact with metal windows and exterior door frames to provide a thermal break. Adhere tape to casing bead and compress during installation.

3.15 FINISHING

.1 Before proceeding with installation of finishing materials ensure the following:

.1 Wallboard is fastened and held close to framing and furring.

.2 Fastening heads in wallboard are slightingly below surface in dimple formed by driving tool.

.2 Levels of Gypsum Wallboard Finish:

.1 Level 0: Temporary construction only.

.2 Level 1: Plenum areas and above ceilings. Where a fire-resistance rating is required finishing should be in accordance with reports of fire tests of assemblies that have met the requirements of the fire rating imposed.

.3 Level 2: Areas of water resistant gypsum backing board under tile, exposed areas where appearance is not critical.

.4 Level 3: Service corridors and areas to receive heavy or medium textured coatings or heavy-duty wall coverings.

.5 Level 4: Areas to receive light textured coatings or lightweight wall coverings.

.6 Level 5: Areas to receive gloss, semi-gloss or flat sheen paints and critical lighting conditions. Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat over entire surface for corridors, long hallways, walls and ceilings longer than 7500 mm or walls higher than 3600 mm , and for all curved or angled wall surfaces.

.3 Finish gypsum wallboard in strict accordance with ASTM C840, GA-214 and GA-216 and as follows:

.1 Fill and tape joints and internal corners and fill screw depressions in board face and smooth out along corner beads and metal strip with joint compound.

.2 Mix joint compound (powder) in accordance with manufacturer's written instructions.

.3 Prefill "V" grooves of rounded edges with special setting type joint compound using a 127mm to 150mm (5" to 6") joint finishing knife. Finish flush with tapered surface ready for tape reinforcing application. Allow prefill material to dry thoroughly before application of embedding compound and tape.

.4 Apply joint compound in thin uniform layer. Embed reinforcing tape accurately centred on joint and securely pressed in, leaving sufficient compound under tape to provide proper bond. Immediately apply skim coat over tape application. Allow to dry thoroughly before application of next coat.

.5 Apply fill coat finishing the tapered depression flush with board surfaces. Allow to dry thoroughly before application of finish coat.

.6 Apply finish coat extending slightly beyond the filler coat and feathered out onto the board surface. Do not apply finish coat to gypsum board scheduled to be sprayed with acoustic surfacing finish.

.7 Sand between coats and following the finishing coat, where necessary, and leave surface smooth and ready for painting.

.8 Finish screw depressions with filler material and finish coat as specified above.

.9 Joint and depression finish shall in no case protrude beyond the plane of the board surface.

.10 Furnish corner beads and metal trim flush with board surface using filler and finishing coats feathered out approximately 50mm (2") and 100mm (4") respectively onto the board surface.

.11 Provide metal casing beads at exposed edges, at junctions of gypsum/cement board with dissimilar material, at control joints and at junction with columns. Casing beads are required at perimeter of gypsum/cement wallboard ceilings and soffits. Fasten with screws at 305mm (12") O.C. along entire length.

.12 Finish gypsum board to receive a Level 4 finish.

.13 Glass Mat Faced Gypsum Board: Full coat of compound for smooth and level surface.

.14 Cement Board Walls and Ceilings:

.1 Joints: Three coat method.

.2 Internal Angles: Two coat method.

.3 Fasteners and Accessories: Three coat method.

.4 Entire Surface: One coat of purpose made compound. Let dry and sand smooth.

3.16 REPAIRS

.1 After taping and finishing has completed, and before decoration, repair all damaged and defective work, including non-decorated surfaces.

.2 Patch holes or openings 13mm (1/2") or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.

.3 Repair holes or openings over 13mm (1/2"), or equivalent size, with 16mm (5/8") thick gypsum wallboard secured in such a manner as to provide solid substrate equivalent to undamaged surface.

.4 Tape and refinish scratched, abraded or damaged finished surfaces including cracks and joints in non-decorated surface to provide smoke tight construction, fire protection equivalent to the fire rated construction and STC equivalent to the sound rated construction.

3.17 PROTECTION

.1 Protect installed products from damage during remainder of construction period.

.2 Remove and replace panels that are damaged.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 The work in this section includes supply and installation for floor and wall tiles materials, including setting materials and components but not limited to the following:

.2 Waterproof membrane

.3 Crack isolation membrane

.4 Tile bonding accessories

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 American National Standards Institute/Ceramic Tile Institute (ANSI/CTI):

.1 ANSI/CTI A108.1, Specification for the Installation of Ceramic Tile: Collection of 20 ANSI/CTI A108, A118 and A136 Series of Standards on Tile Installation

.3 American Society for Testing and Materials (ASTM):

.1 ASTM C241/C241M, Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic

.2 ASTM C615/C615M, Standard Specification for Granite Dimension Stone

.3 ASTM C627, Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester

.4 ASTM C920, Standard Specification for Elastomeric Joint Sealants

.5 ASTM C1028, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method

.6 ASTM C1178/C1178M, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel

.4 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-75.1, Tile, Ceramic

.5 Terrazzo, Tile and Marble Association of Canada (TTMAC):

.1 2019-2021 Specifications Guide 09 30 00, Tile Installation Manual

.2 Hard Surface Maintenance Guide

1.4 PERFORMANCE REQUIREMENTS

.1 Tile products manufactured and tested to ISO 10545 Series and ANSI A137.1.

.2 Slip Resistance: Minimum dynamic coefficient of friction (DCOF) of 0.42 wet to ANSI A137.1.

.3 Floor Traffic Load Bearing Performance: ASTM C627, meeting minimum moderate duty, and outlined in this section and the TTMAC Guide Specification.

.4 Floor flatness tolerances and preparation for large format tiles should be specified in this Section. Specify starting concrete flatness requirements in Section 03 35 00; add additional flatness

requirements for tile materials 400 x 400 mm (16 x 16 inches) and larger or where tile manufacturers indicate a higher degree of flatness. Coordinate with the Contract Administrator when entire floor areas require the tighter flatness tolerance. Modify the following paragraphs to suit specific project requirements.

.5 Surface Flatness Tolerances:

.1 Small Format Floor Tile less than 100 x 100 mm: Floor flatness as specified in Section 03 35 00 – Concrete Finishing.

.2 Standard Format Floor Tile 100 x 100 mm to 400 x 400 mm: Floor flatness measured to a minimum FF35; equivalent to 5 mm with maximum 2 gaps under a 3 m straightedge measurement.

.3 Large Format Floor Tile larger than 400 x 400 mm: Floor flatness measured to a minimum of FF50; equivalent to 3 mm with maximum 2 gaps under 3 m straightedge measurement.

.4 Wall Tiles: Wall levelling similar to floors tiles having similar sizes listed above.

1.5 PRE-INSTALLATION CONFERENCE

.1 Contractor shall hold pre-installation conference 2 weeks prior to commencing work of this Section. Conference shall be attended by the Contractor, the City, Contract Administrator, concrete finishing subcontractor, tile installers and tile manufacturer's representative, setting bed and grout manufacturer's representative to discuss the following, but not limited to the following;

.1 Substrate conditions, non-structural cracks, structural cracks and preparation requirements.

.2 Floor and wall surface irregularities and levelness tolerances, including all remedial requirements.

.3 Installation of anti-fracturing membranes and setting bed materials.

.4 Installation of tiles and grouting.

.5 Edge details and treatments.

.6 Installation of tile and grout sealers.

.2 Contractor shall ensure that manufacturer's representatives issues written installation instructions at the pre-installation conference, to all parties attending the pre-installation conference and the Contract Administrator, for all tile types, setting beds, grouts and sealers required for the work of this Section.

.3 Contractor shall within 72 hours of the pre-installation conference, prepare minutes of the conference, and issue minutes to all parties attending the pre-installation conference and the Contract Administrator. Contractor shall clearly indicated required actions and by which party.

1.6 SUBMITTALS FOR REVIEW

.1 Product Data: For each product. Include installation instructions for using setting materials and grouts.

.2 Shop Drawings: Plans indicating details of special fittings, expansion joints, control joints, and joint layout, graining orientation of tile, and pattern.

.3 Samples:

.1 Submit 610 mm x 610 mm (24" x 24") sample panel of each type and colour tile, . apply to a rigid board with setting compound, grout and a dummy control joint showing sealant as specified. Identify samples by project number, date, name of sub-contractor and tile type. Tile and grout used in the building shall correspond to appearance of approved samples in all respects. Do not install tile until samples are approved.

.2 Upon Contract Administrator's request submit samples of base, trim and fittings.

1.7 SUBMITTALS FOR INFORMATION

.1 Installation Data: Manufacturer's special installation requirements.

.2 Tile setting material manufacturer's review report.

.3 Field test reports.

.4 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentation in accordance to the following:

.1 Indoor Environmental Quality: EQ Credit 4.1 - Low-Emitting Materials: Adhesives & Sealants

1.8 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

1.9 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials: Provide a minimum 3 percent of total of each type and of each colour of floor tile and trim used from same production run for project maintenance upon completion. Provide 2 boxes of each type and colour of wall tile. Neatly package and identify materials and deliver to location specified by The City.

1.10 QUALITY ASSURANCE

.1 Perform work in accordance with TTMAC Specification Guide, Tile Installation Manual.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.3 Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

.4 Tile Setting Material Manufacturer's Review:

.1 Prior submitting Submittals obtain tile setting manufacturer’s review and approval for conformance of tile installation methods and procedures with warranty requirements.

.2 Prepare and submit report signed by the tile setting manufacturer.

.3 Review of waterproofing membrane installation, and provide required testing ensuring waterproofing membrane manufactures recommended thickness is achieve.

1.11 MOCK-UP

.1 Provide:

.1 1500 x 1500 mm mock-up of a sample installation illustrating in a cutaway fashion the floor tile, wall tile, accent tile (as required), base and grout for the following:

.1 Washroom floor and wall.

.2 Shower floor and wall.

.2 Build mock-ups using personnel, materials, and methods of construction that will be used at Project site

.3 Locate where directed by Contract Administrator.

.4 Allow for multiple iterations until mock-up approved by Contract Administrator.

.5 Retain approved mock-ups as standard of quality for installation.

1.12 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store material in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

.4 Restrict traffic by other trades during installation.

.5 Provide adequate protection of completed tiled surfaces to prevent damage by other trades until final completion of this project. Minimum protection shall consist of 4 mil polyethylene sheets lapped 100 mm (4") and taped.

.6 Heavily travelled areas shall have additional 13 mm (1/2") thick fibreboard sheet protection with taped joints over polyethylene sheet protection as specified above.

.7 Protect exposed edges of floor tile with same thickness as tile x 102 mm (4") wide tapered strip of plywood adhered to floor until adjoining floor finish is to be installed.

1.13 SITE CONDITIONS

.1 Ambient Conditions: Apply tile after completion of work by other Sections is complete; to surfaces sufficiently dry, clean, firm, level, plumb and free from oil or wax or any other material deleterious to tile adhesion and as follows:

.1 Temperature: Maintain tile materials and substrate temperature between TTMAC recommended minimum and maximum temperature range; unless indicated otherwise by manufacturer, for 48 hours before and during installation until materials are fully set and cured; provide additional heat during winter months or at any other time when there is a risk that surface temperatures may drop below minimum recommended temperatures.

.2 Ventilation: Maintain adequate ventilation where Work of this Section generates toxic gases or where there is a risk of raising relative humidity to levels that could damage building finishes and assemblies.

1.14 WARRANTY

.1 Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions, but for a period of five (5) years from date of Substantial Performance, and agree to promptly make good defects which become evident during the warranty period without cost to the City. Defects shall include but not be limited to the following; cracking, crazing, discolouration, staining, pitting, splitting and deformation of tiles and grout.

2 Products

2.1 MATERIALS – PORCELAIN TILE (PCT)

.1 ANSI 137.1; cushion edges; colour through rectified porcelain tiles.

.2 Slip Resistance: Required.

.3 Tile Trim: Provide coved tile bases, nosings, finger grip, toe grip, moulded trimmers for external and internal angles and projections as shown in Drawings.

.4 Refer to Finishes Schedule for type, product, size, colour and finish textures.

2.2 MORTAR AND GROUT MATERIALS – GENERAL

.1 Acceptable Tile Setting Materials: Subject to conformance to requirements, mortar and grout materials listed below shall be of a uniform quality for each adhesive, and grout component from a single manufacturer and each aggregate from one source or producer as follows:

.1 Laticrete International Inc.,

.2 Mapei Corporation,

.3 TEC Incorporated Building Products Group, an H.B. Fuller Company,

.4 Flextile Ltd.

.2 Setting and Grouting Materials: Conform to material standards in ANSI's Specifications for the Installation of that apply to materials and methods specified.

.1 Grout Colours: Unless otherwise indicated, to be selected by Contract Administrator.

.2 Grout joints: for stone floor tiles provide grout material capable of maintaining maximum 3 mm grout joints.

.3 Source limitations: All materials shall be from one manufacturer, forming a complete system.

.4 Products: Provide like products from same production run. Install products in sequence from sequentially numbered dye lots.

2.3 MORTAR AND GROUT SETTING SYSTEMS

.1 Materials General: to ANSI A108/A118/A136.1 and TTMAC Detail indicated:

.1 Thinset Mortar:

.1 4237 latex additive and 211 Crete filler powder by Laticrete,

.2 Kerabond with Keralastic by Mapei ,

.3 TA 382 Ultimate LFT by TEC, HB Fuller.

.4 '51 Premium Wall & Floor Thin-Set Mortar with 44 Acrylic Additive' by Flextile.

.2 Trowelable Underlayment and screed Compound:

.1 226/3701 mortar mix by Laticrete,

.2 Topcem by Mapei, or

.3 TA 305 Fast Set Deep Patch by TEC, HB Fuller.

.4 FAST-SET SCREED BY Flextile

.3 Grout: ANSI A108/A118/A136.1:

.1 Standard for dry locations:

.1 SPECTRALOCK PRO Premium Grout by Laticrete, or

.2 Mapei UltracolorPlus, or

.3 PowerGrout by TEC, HB Fuller or

.4 1600 RSG by Flextile

.2 Epoxy Grout: Public Washrooms

.1 SPECTRALOCK PRO Premium Grout by Laticrete, or

.2 Kerapoxy by Mapei,

.3 AccuColour EFX by TEC, HB Fuller.

.4 FLEX-EPOXY 100 GROUT by Flextile

.4 Crack suppression membrane type 1 and type 2 as required.

2.4 TILE SETTING SYSTEMS FOR WET AREAS

.1 Materials General: to ANSI A108/A118/A136.1 and TTMAC Detail indicated:

.1 Scratch/Skim/ Bond Coat:

.1 211/4237 by Laticrete,

.2 Kerabond mixed with Keralastic additive by Mapei,

.3 TA392/393 SUPERFLEX ULTRA PREMIUM THIN SET by TEC

.4 #51 FLOOR & WALL PREMIUM MORTAR MIXED #44 ACRYLIC ADDITIVE by Flextile

.2 Mortar Bed/levelling coat: For bed thicknesses over 40 mm, suspend reinforcing mesh within mortar bed.

.1 226/3701 mortar mix by Laticrete,

.2 Topcem with Planicrete AC by Mapei,

.3 TA305 FAST SET DEEP PATCH WITH PATCH ADDITIVE by TEC,

.4 FAST-SET SCREED or 4:1 DRY PACK with #44 Acrylic Additive by Flextile

.3 Waterproof Membrane: ANSI A118.10

.1 Hydroban by Laticrete

.2 Aquadefense by Mapei

.3 TA 316 Hydraflex by TEC, HB Fuller

.4 WP-900 HYDRO-BLOCK by Flextile

.4 Grout: ANSI A108/A118/A136.1 Epoxy Grout:

.1 SPECTRALOCK PRO Premium Grout by Laticrete

.2 Kerapoxy by Mapei

.3 AccuColour EFX by TEC, HB Fuller

.4 FLEX-EPOXY 100 GROUT by Flextile

.5 Fibreglass reinforcing mesh and cleavage membrane, as recommended by manufacture.

2.5 ACCESSORIES

.1 Water: Fresh, clean, potable, free from deleterious matter, acids or alkalis.

.2 Sealant: movement and joint sealants as specified in Section 07 92 00 –Sealants.

.3 Tile Backer Board: As Specified in Section 09 21 00 – Gypsum and Cement Board Assemblies.

.4 Trims:

.1 Straight Edge Strips: Roll formed stainless steel edge strips, 3 mm wide at top edge; height as required to suit tile installation; with integral perforated anchoring leg for setting the strip into the setting material:

.1 Basis-of-Design Materials: Schiene AE by Schlüter.

.2 Transition Edge Strips: Roll formed stainless steel edge strips; height as required to suit tile installation; with integral perforated anchoring leg for setting the strip into the setting material andsloped transition

.1 Basis-of-Design Materials: Reno-U by Schlüter.

.5 Provide fillers, primers, reinforcing fabric and all other materials and accessories as recommended by the crack suppression membrane manufacturer.

.6 Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers and as follows:

.1 Job Site Cleaner: Phosphoric acid/nitric acid based cleaning solution mixed in accordance with cleaner manufacturer's recommendations and as recommended by tile manufacturer.

.2 Maintenance Cleaner: Non-toxic, electrolytic, biodegradable, non-ammonia containing, pH controlled cleaning solution mixed in accordance with manufacturer's recommendations.

2.6 CRACK SUPPRESSION MEMBRANE

.1 Crack Suppression Membrane Type 1 (For non-structural cracks less than 3 mm wide). Provide one of the following, or equivalent from listed manufacturer:

.1 One component, water based, elastomeric type crack suppression membrane capable of spanning cracks up to 3 mm wide without failure.

.1 WP-900 WATER PROOF & CRACK ISOLATION MEMBRANE by Flextile

.2 Or Contract Administrator reviewed substitution from by listed manufacture.

.2 One component, liquid rubber, elastomeric type crack suppression membrane reinforced with reinforcing fabric and capable of spanning cracks up to 3 mm wide without failure.

.1 Mapelastic CI by Mapei,

.2 Laticrete 9235 Anti-Fracture Membrane by Laticrete International Inc. or

.3 TA 316 Hydraflex by TEC, HB Fuller.

.4 WP-980 WATERPROOF & CRACK ISOLATION MEMBRANE by Flextile

.2 Crack Suppression Membrane Type 2 (For non-structural cracks 3 mm wide and greater, and all structural cracks). Provide one of the following, or equivalent from listed manufacturer:

.1 One component, liquid rubber, elastomeric type crack suppression membrane reinforced with reinforcing fabric and capable of spanning cracks 3 mm wide and greater without failure.

.1 Laticrete 9235 Anti-Fracture Membrane by Laticrete International Inc. or

.2 TA 316 Hydraflex by TEC, HB Fuller.

.3 WP-980 WATERPROOF & CRACK ISOLATION MEMBRANE by Flextile

2.7 MORTAR AND GROUT MIXING

.1 Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

.2 Add materials, water, and additives in accurate proportions.

.3 Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated or specified.

3 Execution

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Verify that surfaces are ready to receive work.

.1 Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated or specified.

.2 Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

.3 Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Contract Administrator.

.3 Verify sealants and grout are cured for manufactured recommended periods at required temperatures and relative humidity conditions, before water immersion.

.4 Crack Suppression Membranes:

.1 Prepare all surfaces of non-structural and structural cracks in strict accordance with the crack suppression membrane manufacturer's written instructions.

.2 Prime and fill all surfaces of non-structural and structural cracks in strict accordance with the crack suppression membrane manufacturer's written instructions.

.5 Commencement of installation shall signify complete acceptance of surfaces and conditions.

3.2 PREPARATION

.1 Surface Preparation:

.1 Make backing surfaces level and true to a tolerance in plane of ± 3 mm in 2 m (1/8” in 8’) for walls and ± 3 mm in 3 mm (1/8” in 10’) for floors using levelling bed mortar.

.2 Surfaces shall be structurally sound, well fastened, clean and free from dust, oil, grease, paint, tar, wax, curing agents, primers, sealers, form release agents or any deleterious substances that may act as bond barriers.

.3 Backing surfaces shall be dry and fully cured. Dampness must not exceed 5% by volume.

.2 Examine concrete substrate, repair as required to produce level, clean surface for new tile installation. Repair Work shall include levelling, filling, grinding or cutting, in accordance with Section 03 35 00 – Concrete Finishing.

.3 Work of other trades that are required before new tile installation (i.e. electrical conduit installed below ceramic tile) shall be installed, complete and approved before tile installation.

.4 Fill cracks, holes, and depressions in concrete substrates for tiling installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

.5 Check as per ASTM F710 for Concrete Preparation for excessive moisture levels & pH of the slab.

3.3 INSTALLATION - GENERAL

.1 Installation of the tile shall be by thin-set method, as indicated on the drawings and as specified herein;

.1 Install wall tile to gypsum wallboard and moisture resistant wallboard in dry areas using latex modified thin-set setting bed and latex modified wall grout in strict accordance with tile manufacturers written installation instructions as per the pre-installation conference.

.2 Apply floor tile and prepare floor slabs in strict accordance with tile manufacturers written installation instructions as per the pre-installation conference.

.2 Install mortar bed, tile, and grout to referenced TTMAC Manual and TTMAC systems listed.

.3 Thoroughly clean surfaces to which tile is to be applied.

.4 Back butter all floor tile.

.5 Neatly cut tile around fitments, fixtures, access panels, and the like. Splitting of tile is expressly prohibited except where no alternative is possible. Form intersections, corners and returns accurately.

.6 Finish surfaces flat and level or, sloped and graded as required.

.7 Joint Widths: Install tile with the following joint widths, unless indicated on drawings:

.1 Ceramic Mosaic Tile: 2 mm (1/16”)

.2 Wall Tile: 2 mm (1/16”)

.3 Floor Tile: 6 mm (1/4”), unless otherwise indicated on the Drawings.

.4 Make joints consistent width and alignment within tile area.

.5 Maintain 2/3 of grout joint depth free of setting material.

.8 Joints in base shall match floor patterns. Joints shall be watertight without voids, cracks or excess grout.

.9 Lay out tile so that fields or patterns are centred on wall areas or architectural features and so that no tile less than 1/2 size occurs.

.10 Arrange and set recessed accessories in tile work so that they are evenly spaced, centred with joints and set true with correct projection. Rigidly install accessories.

.11 Provide manufacturer's standard trim pieces at changes of direction and at terminations. Unless otherwise indicated provide the following corner and edge conditions:

.1 Internal horizontal corners: Coved.

.2 External vertical and horizontal corners: Bullnosed.

.3 Internal vertical corners and unexposed edges: Square.

.12 Install tiles in patterns and locations as indicated on drawings.

.13 Install wall tile full wall height unless shown otherwise.

.14 Coordinate work of this Section with work of other Sections for items requiring to be recessed into work of this Section.

.15 Sound tiles after setting and remove and replace tiles not fully bedded.

.16 Re-point joints after cleaning to eliminate imperfections. Avoid scratching tile surfaces.

.17 Finished tile work shall be clean and free of tiles which are pitted, chipped, cracked or scratched. All damaged tile shall be removed and replaced.

.18 Where indicated on Drawings or as required, install continuous single piece metal edge trims centred under doors in closed position and other locations where tile meets other floor finishes.

.19 Allow tile to set for a minimum of 48 hours prior to grouting.

3.4 GROUTING

.1 Grout tiles in accordance with ANSI A108.10 and as specified herein.

.2 When grouting a fresh laid floor, make certain that traffic and grouting will not cause movement of floor in setting bed. Protect floor by using kneeling boards or gypsum board to defend floor against traffic while grouting.

.3 Mix grouts and install in strict accordance with the manufacturer's instructions.

.4 Excess grout shall be removed from the surface of tiles using the edge of a rubber float held at a 45 deg angle, moving it diagonally to the joints. Fill all gaps and air holes.

.5 Do not allow grout to harden on face of tile. Refer to manufacturer's instructions for thorough removal.

.6 Floors which required damp curing shall be cured for the required length of time using heavy kraft paper, not polyethylene sheets. Consult manufacturer for instructions.

3.5 CONTROL JOINTS AND SEALING

.1 Control joints of a flexible caulking material shall be placed every 4877mm to 6096mm (16 to 20') apart, directly over existing control joints and/or where indicated on drawings or as required in accordance with TTMAC Detail No. 301MJ-2019-2021, Details E, F and G, whichever is applicable. Control joints shall be placed around the floor perimeter at walls, around columns, and where tile abuts other hard materials or vertical surfaces. Saw cutting of tile after installation is prohibited. Tile shall be cut if required and installed along each side of control joints.

.2 Expansion joints must always be placed directly over all slab expansion joints in accordance with TTMAC Detail No. 301MJ-2019-2021, Details A and B, whichever is applicable.

.3 Locate expansion, control, contraction, and isolation joints, as indicated below, unless specifically indicated otherwise on the Drawings:

.1 Interior: 5 m (16') maximum: 6 mm (1/4") joint width.

.2 Exterior: 4 m (12') maximum: 9.5 mm (3/8") joint width.

.4 Joints around fixtures, pipes or other fittings shall be sealed with a sealant. Refer to Section 07 92 00 – Sealants for type of sealants to be used.

.1 Colour of sealant shall match grout as selected later by Contract Administrator.

3.6 WATERPROOFING

.1 Install waterproofing in accordance with waterproofing manufacturer's written instructions to produce a waterproof membrane of uniform thickness bonded securely to substrate.

.2 Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.7 CLEANING AND FINISHING

.1 Clean tiled areas after grouting has cured, using compatible solutions and methods as recommended by the manufacturer.

.2 Remove grout residue from tile as soon as possible.

.3 Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation.

.4 Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning.

.5 Flush surface with clean water before and after cleaning.

.6 Leave finished installation clean and free of cracked, chipped, broken, unbonded, or other tile deficiencies.

3.8 PROTECTION OF FINISHED WORK

.1 Protect installed work.

.2 Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of:

.1 Acoustical panel ceiling systems (ACT).

.2 Suspended metal grid ceiling system and perimeter trim.

.3 Supplementary acoustic insulation over system units.

.4 Site quality control.

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM C635/C635M, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

.2 ASTM C636/C636M, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels

.3 ASTM E1264, Standard Classification for Acoustical Ceiling Products

.4 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

.1 Suspension System:

.1 Determine the superimposed loads that will be applied to suspension systems by components of the building other than the ceiling and ensure that adequate hangers are installed to support the additional loads in conjunction with the normal loads of the system.

.2 Design supplemental suspension members and hangers where width of ducts and other construction within ceiling plenum produces hanger spacing that interferes with location of hangers at required spacing to support standard suspension system members:

.3 Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

.4 Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of L/360.

.5 Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to applicable code.

.6 Surface-Burning Characteristics: Conform to CAN/ULC S102 or ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Coordinate layout and installation of ceilings with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, and fire-suppression system.

1.6 SUBMITTALS FOR REVIEW

.1 Product Data: Submit product data for each type of product specified.

.2 Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling mounted items indicating the following:

.1 Ceiling suspension system members.

.2 Method of attaching suspension system hangers to building structure.

.3 Ceiling mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special mouldings at walls, column penetrations, and other junctures of acoustic ceilings with adjoining construction.

.3 Samples:

.1 Submit two 300 x 300 mm samples illustrating material and finish of each type of acoustic unit.

.2 Submit two 300 mm long samples of suspension system main runner, cross runner, and perimeter moulding.

1.7 SUBMITTALS FOR INFORMATION

.1 Qualifications Data: For Installer.

.2 Installation Data: Manufacturer's special installation requirements, including perimeter conditions requiring special attention.

.3 Professional Structural Engineer’s Letters of Assurance:

.1 Provide letters or completed City-prescribed forms signed by the professional structural engineer used to prepare the shop drawings, stating that the ceiling system has been designed accordance with the structural performance requirements of the applicable codes, including verification that:

.1 Specified products have been used.

.2 Designs and installations as tested, have been installed on the Project.

.3 Loads and movement requirements have been achieved.

.4 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentation in accordance to the following:

.1 Materials & Resources:

.1 MR Credit 4 - Recycled Content: 10% (post-consumer + ½ pre-consumer)

.2 Indoor Environmental Quality:

.1 EQ Credit 4.1 - Low-Emitting Materials: Adhesives & Sealants

1.8 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials:

.1 Acoustical Ceiling Units: Full size units equal to three percent of quantity installed, of each tile type.

.2 Suspension-System Components: Quantity of each concealed grid and exposed component equal to three percent of quantity installed.

1.9 QUALITY ASSURANCE

.1 Conform to Ceilings and Interior Systems Contractors Association (CISCA) Ceiling Systems Handbook requirements.

.2 Qualifications of Installer: Approved by suspension system manufacturer.

1.10 REGULATORY REQUIREMENTS

.1 Conform to applicable code for combustibility requirements for materials.

.2 Conform to applicable code for seismic requirements for ceiling system.

1.11 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off-the-ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store material in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

1.12 SITE CONDITIONS

.1 Ambient Conditions: Install acoustic unit ceilings only when building is enclosed, has sufficient heat, when overhead mechanical and electrical work is complete, and dust and moisture producing activities are complete; maintain uniform temperatures and relative humidity within range recommended by material manufacturer from the time of installation until Substantial Performance for the project; make adjustments to temperature and humidity gradually within tolerances indicated by manufacturer.

1.13 WARRANTIES

.1 Provide two (2) year warranty by manufacturer of acoustic panels covering defects in products and failure to meet specified requirements.

2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include the following:

.1 CGC Inc. a USG Company.

.2 Armstrong World Industries Canada Ltd,

.3 CertainTeed Gypsum Canada Inc. a Division of Saint-Gobain, or

.4 Rockfon LLC.

2.2 METAL SUSPENSION SYSTEMS

.1 Grid Components: ASTM C635/C635M, intermediate duty; exposed, downward access removable T; components die cut and interlocking; minimum 38 mm high bulb tee design.

.1 Recycled Content: minimum 50 %

.2 Grid Materials: Hot dip galvanized steel with factory paint finishes.

.3 Grid Finish: White, manufacturer’s standard.

.4 Module: Sized as appropriate to acoustic panel size.

.5 Mouldings:

.1 Perimeter Moulding: Formed to provide shadow reveal profile moulds unless shown otherwise in baked white enamel finish.

.6 Exposed Suspension System: Provide standard exposed 'T' bar system: zinc-coated steel with baked white enamel finish for exposed surfaces in colour to match acoustic panels.

.1 Acceptable Products:

.1 DONN Brand Suspension System, 25 mm exposed face by CGC Inc.

.2 Prelude XL HRC manufactured by Armstrong World Industries Canada Ltd.

.3 15/16” Classic Stab System by CertainTeed Gypsum Canada.

.4 Chicago Metallic 1200HRCMax 15/16” Stab System by Rockfon LLC.

2.3 ACOUSTIC CEILING PANELS (ACT)

.1 Provide manufacturer's standard panels of configuration indicated that comply with ASTM E1264 classifications as designated by the nominal values for types, patterns, acoustic ratings, and light reflectance class, unless otherwise indicated.

.2 Surface burning properties, all types: Flame spread of 25 or less and smoke developed of 50 or less when tested in accordance with CAN/ULC S102, substantiated by ULC labels on materials supplied.

.3 Acoustic Panel (AT-1): ASTM E1264, minimum NRC 0.75 and CAC 35, square edge, 610 mm x 1200 mm x 19 mm.

.1 Acceptable Products:

.1 MARS Acoustical Ceiling Panels by CGC Inc.

.2 ULTIMA Lay-In series by Armstrong Ceiling.

.3 Symphony M 70 series by CertainTeed Ceilings Canada,

.4 Acoustic Panel (AT-2): ASTM E1264, minimum NRC 0.8 and CAC 40, square edge, 610 mm x 1200 mm x 19 mm.

.1 Acceptable Products:

.1 MARS High NRC/ CAC Acoustical Ceiling Panels by CGC Inc.

.2 ULTIMA High NRC Lay-In series by Armstrong Ceiling.

.3 Symphony M 80 series by CertainTeed Ceilings Canada,

2.4 ACCESSORIES

.1 Accessories: Stabilizer bars, clips, perimeter mouldings and splices required for suspended grid system.

.2 Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

.3 Ties Wire: minimum 1.98 mm (14 ga.) Ø steel wire, galvanized.

.1 Hanger Attachments to Concrete: 1 #12 galvanized annealed steel wire for support of a maximum weight of 68 kg. per hanger; #9 galvanized annealed steel wire for support of a maximum weight of 140 kg. per hanger; 4.5 mm diameter galvanized annealed steel rod to support a maximum weight of 250 kg. per hanger.

.4 Anchors: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E488 by an independent testing agency; Minimum tensile strength 390 MPa.

.5 Acoustic Sealant for Perimeter Mouldings: As specified in Section 07 92 00 – Sealants.

.6 Edge Mouldings and Trim: In profile indicated or, if not indicated, manufacturer's standard mouldings for edges and penetrations that fit acoustical panel edge details and suspension systems; edges hemmed, formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

3 Execution

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION – GENERAL

.1 Install acoustical ceilings according to CISCA publication Ceiling Systems Handbook.

3.3 INSTALLATION - LAY-IN GRID SUSPENSION SYSTEM

.1 Install suspension system to manufacturer instructions and ASTM C636/C636M, and as supplemented in this section.

.2 Install system in accordance with ASTM E580/E580M.

.3 Install system capable of supporting imposed loads to a deflection of L/360 maximum.

.4 Lay out system to a balanced grid design with edge units no less than 50 percent of acoustic unit size, unless otherwise detailed.

.5 Install after major above ceiling work is complete. Coordinate the location of hangers with other work.

.6 Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

.7 Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

.8 Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 150 mm of each corner; or support components independently.

.9 Do not eccentrically load system, or produce rotation of runners.

.10 Perimeter Moulding:

.1 Install edge moulding at intersection of ceiling and vertical surfaces into bed of acoustic sealant.

.2 Use longest practical lengths.

.3 Overlap corners.

.4 Provide at junctions with other interruptions.

3.4 INSTALLATION - ACOUSTIC UNITS

.1 Install acoustic units to manufacturer's instructions.

.2 Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.

.3 Install units after above ceiling work is complete.

.4 Install acoustic units level, in uniform plane, and free from twist, warp, and dents.

.5 Cutting Acoustic Units:

.1 Cut to fit irregular grid and perimeter edge trim.

.6 Where round obstructions occur, provide preformed closures to match perimeter moulding.

.7 Where indicated, lay acoustic insulation for a distance of 1 200 mm either side of acoustic partitions.

.8 Install panel hold-down clips, where specified, to retain panels tight to grid system.

3.5 ERECTION TOLERANCES

.1 Maximum Variation from Flat and Level Surface: 3 mm in 3 m.

.2 Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.6 SITE QUALITY CONTROL

.1 Engage a professional structural engineer experienced in design and installation of this work and licensed in the Province where the Project is located to:

.1 Perform timely and regular inspections.

.2 Verify installation conforms to applicable code.

.3 Prepare and submit inspection reports.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes linear metal ceiling pans, hangers, and other accessories for interior and exterior application as indicated in the drawings.

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.3 AAMA 2603, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

.4 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.6 ASTM E580/E580M, Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.

1.4 QUALITY ASSURANCE

.1 Installer: Trained and approved by the manufacturer and having a minimum three years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.

.2 Finish Ceiling System: Square with adjoining walls and level within 1:1000, in true plane, free from distorted, warped, soiled or damaged components.

.3 Metal Suspension System Standard: Complying with ASTM C635 Intermediate Duty and C636 except as otherwise specified.

.4 Deflection Limitation, Completed Ceiling: L/360 of span maximum deflection.

.5 Maintenance Seminars: Engage a factory authorized service representative to instruct TransLink Representative on proper care, cleaning and maintenance procedures.

.6 Pre-Installation Meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.7 Manufacturer’s Site Inspection: Have the manufacturer’s technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer’s inspection reports and verification that the work of this Section is correctly installed.

.8 Seismic Assemblies: Provide work designed and installed to withstand the effects of earthquake motions in accordance with authorities having jurisdiction.

.9 Design Soffits for Exterior Application to meet the following requirements.

.1 Wind Loads: Design work to resist positive and negative wind loads, and snow loads as required by the governing building code without causing rattling, vibration or excessive deflection of panels, over stressing of fasteners, clips and other detrimental effects on soffit system.

.2 Structural and Thermal Movements: Accommodate movement of supporting structural framing and movement caused by thermal expansion and contraction of system component parts without causing bowing, buckling, oil canning, failure of joint seals, excessive stress on fasteners or any other detrimental effects.

.3 Deflection: Maximum L/240 of clear span at design loads.

.10 Sample Installation: Construct on site a 10 m x 10 m (30' x 30') minimum sample installation of each type acoustical ceiling. Modify sample installation as often as necessary to obtain Contract Administrator's acceptance. Accepted sample installation may become part of completed Work if undisturbed at time of Substantial Performance.

.1 Include electrical and mechanical fixtures in sample installation as directed by Contract Administrator.

1.5 SUBMITTALS

.1 Product Data: For each type of product indicated.

.2 Product Certification: Manufacturer's certifications that products comply with specified requirements and governing codes including product data, laboratory test reports and research reports showing compliance with specified standards.

.3 Shop Drawings: Submit shop drawings for reflected ceiling plans (RCP's), drawn to scale, and indicating penetrations and ceiling mounted items. Show the following details:

.1 Bearing the seal and signature of the professional engineer responsible for the engineering design of Soffit Work of this Section.

.2 Reflected Ceiling Plan(s): Indicating metal ceiling layout, ceiling mounted items and penetrations.

.3 Suspension System, Carrier and Component Layout.

.4 Details of system assembly.

.4 Samples for Verification: Full-size units (or as specified below) of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics. Submit samples for each type specified.

.1 300 mm long x full width of metal ceiling panel units.

.2 300 mm long samples of each exposed molding or trim.

.3 300 mm long samples of each suspension component.

.5 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentation in accordance to the following:

.1 Materials & Resources:

.1 MR Credit 4 - Recycled Content: 10% (post-consumer + ½ pre-consumer)

.2 MR Credit 5 - Regional Materials: 20% Extracted and Manufactured Regionally

.2 Indoor Environmental Quality:

.1 EQ Credit 4.1 - Low-Emitting Materials: Adhesives & Sealants

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver products to Project site in original, unopened packages and store in a fully enclosed, conditioned space, protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

.2 Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

.3 Handle products carefully to avoid chipping edges, bent or other damages.

1.7 PROJECT CONDITIONS

.1 Do not install work until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 COORDINATION

.1 Coordinate layout and installation of work of this Section with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 WARRANTY

.1 Provide specified manufacturer's warranty against defects in workmanship, discoloration, or other defect considered undesirable by the Architect or Employer.

.2 This warranty shall remain in effect for a minimum period of one (1) year from date of initial acceptance.

1.10 EXTRA STOCK

.1 Extra Materials: Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Only typical system components are included with attic stock.

.1 Metal Ceiling Units: Full-size units equal to 2 percent (2%) of amount installed.

.2 Ceiling Suspension System Components: Quantity of each grid and exposed component equal to 2 percent (2%) of amount installed.

2 Products

2.1 MANUFACTURERS

.1 Specified Products: Product specified in this Section is based on Paraline Plus Linear Metal Systems manufactured by USG Ceilings. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

.1 Other Acceptable Manufacturers:

.1 Armstrong World Industries Canada Ltd,

.2 CertainTeed Gypsum Canada Inc. a Division of Saint-Gobain, or

.3 Rockfon LLC.

2.2 MATERIAL – METAL LINEAR PANELS

.1 Linear Panel: minimum 0.8 mm (0.032") thick aluminum sheet, square edges profile; 178 mm (7") wide, 25 mm (1") deep, 3660 mm (12') length.

.1 Panel (LC-1): Exterior application, include recess insert filler, colour black finish.

.2 Panel (LC-2): Interior application, perforated panel, includes sound absorbent fabric felt, no recess insert.

.2 Panel Closure: Open joints, edges to manufacturer's standard details.

.3 Panel Finishes: Prefinished coat to manufacturer's wood finish paint on panel. Refer to Section 09 06 00 Finishes Schedules for colour requirements.

2.3 MATERIAL – METAL SUSPENSION AND HANGER SYSTEMS

.1 Carrier: Minimum 0.9 mm (0.038") roll-formed aluminum section with hook shaped tabs spaced to receive ceiling panels at 50 mm (2") on center and 20 mm (27/32") apart. Support holes spaced 100 mm (4") on center

.1 Direct mount application: Channel shaped, with hook shaped tabs allow panels to snap-on at appropriate intervals.

.2 Suspension mount application: Universal hat shaped, with hook shaped tabs allow panels to snap-on at appropriate intervals

.3 Finish: Factory applied black enamel.

.2 Anchors in Concrete: Post-installed carbon steel expansion anchors zinc plated to ASTM B633, with holes or loops for attaching hangers and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing in accordance with ASTM E488 or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

.3 Wire Hangers, Braces and Ties: ASTM A641/A641M, Class 1 zinc coating, soft temper, minimum 2.6 mm (12 gauge).

.4 Hanger Rods, Flat and Channel Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

.5 Angle Hangers: Angles with legs not less than 22 mm (7/8") wide; formed with 1 mm (0.04") thick, galvanized steel sheet to ASTM A635/A635M, Z275 coating designation; with bolted connections and 8 mm (5/16") diameter bolts.

.6 Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

.7 Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

.8 Hold-Down Clips: Galvanized steel spring clips, manufacturer's standard.

2.4 MATERIAL – ACCESSORIES

.1 Edge Mouldings and Trim: In profile indicated or, if not indicated, manufacturer's standard mouldings for edges and penetrations that fit linear panel edge details; edges hemmed, formed from sheet metal of same material, finish, and color as linear metal panel.

.2 Sound-Absorbent Fabric Felt: Black, nonwoven, non-flammable, sound-absorbent fabric layer, sized to fit concealed surface of pan, surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing to ULC S102.

.1 Bond fabric layer to pans in the factory with manufacturer's standard non-flammable adhesive.

.3 Air Distribution Devices: Provide distribution devices that are independently suspended, adjustable from below finished ceiling, capable of being concealed behind (invisible to view) and fully integrated with ceiling system so as to allow no interruption of ceiling components.

.4 Lighting Fixtures: Provide fixtures capable of being fully integrated with ceiling system and requiring no interruption of ceiling components, that are independently suspended, and as selected to conform to lighting criteria specified in Division 26.

3 Execution

3.1 EXAMINATION

.1 Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Coordination: Furnish layouts for anchors, clips, and other ceiling anchors whose installation is specified in other Sections.

.2 Measure each ceiling area and establish layout of acoustical metal pan units to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width units at borders, and comply with layout shown on reflected ceiling plans.

.3 Survey substrate for wall attachment to assure squareness and proper elevation for wall panel installation.

3.3 INSTALLATION

.1 General: Install acoustical metal pan ceilings, per manufacturers shop drawings provided, per manufacturer's written instructions and to comply with publications referenced below.

.1 Standard for Ceiling Suspension System Installations - ASTM C636.

.2 National Building Code of Canada standards Seismic data.

.2 Suspend ceiling hangers from building's structural members, independent of walls, pipes, ducts and metal decks.

.3 Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

.4 Splay hangers only where required and, if permitted with fire resistance rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.

.5 Where ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers. Size supplemental suspension members and hangers to support ceiling loads within performance limits specified.

.6 Where used secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

.7 Space hangers not more than 2440 mm (48”) on center, along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 300 mm (12”) from ends of each member. Supply supporting calculations from licensed Structural Engineer verifying hanger spacing meets all requirements, when spacing exceed those recommended.

.8 Fine level grid to 3 mm (1/8”) in 3 m (10’) from specified elevation(s), square and true.

.9 Adjust suspension system runners so they are square (within 0.5 degree from 90 degrees) and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

.10 Secure bracing wires to ceiling suspension members and to supports acceptable to Contract Administrator and inspector. Suspend bracing from building's structural members and / or structural deck, as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs(unless directed otherwise).

.11 Install suspension system carriers so they are aligned and securely interlocked with one another.

.12 Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pan. Method of edge trim attachment and design of edge trims to be approved by Architect.

.1 Screw attach moldings to substrate at intervals not more than 450 mm (18”) O.C. and not more than 150 mm (6”) from ends, leveling with ceding suspension system to a tolerance of 3 mm in 3 m (1/8” in 10’). Miter corners accurately and connect securely.

.2 Do not use exposed fasteners, including pop rivets, on moldings and trim without prior written approval. Or unless detailed otherwise.

.13 Scribe and cut linear metal panel units for accurate fit at penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.

.14 Install linear metal panel units in coordination with suspension system.

.1 Install directionally patterned or textured panels in directions indicated on approved shop drawings. Panel-joints shall flow smoothly and in a straight line within 3 mm in 3 m (1/8” in 10’). Intersections shall be continuous.

.2 Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.

.3 Remove protective film from panels only when space is completely clean and free of airborne particles. Use white cotton gloves for final installation of panels into grid system.

3.4 ADJUSTMENT AND CLEANING

.1 Adjust components to provide uniform tolerances.

.2 Clean exposed surfaces of linear panel ceilings, including trim, edge mouldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touch up of minor finish damage.

.3 Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes, but not limited to, the following:

.1 Resilient tile materials:

.1 Vinyl composition floor tile

.2 Vinyl Static Dissipative Tile

.2 Resilient accessories:

.1 Resilient wall bases

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM F1066, Standard Specification for Vinyl Composition Floor Tile

.2 ASTM F1516, Standard Practice for Sealing Seams of Resilient Flooring Products by the Heat Weld Method (when Recommended)

.3 ASTM F1700, Standard Specification for Solid Vinyl Floor Tile

.4 ASTM F1861, Standard Specification for Resilient Wall Base

.5 ASTM F1869, Standard Test Method for Measuring Moisture Vapour Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

.4 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Close spaces to traffic during flooring installation and until time period after installation recommended in writing by manufacturer; install flooring and accessories after other finishing operations, including painting and ceiling construction have been completed.

.2 Pre-Installation Conference: Conduct conference at Project site, to verify project requirements, substrate conditions, patterns and layouts, coordination with other Sections affected by work of this Section, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 SUBMITTALS

.1 Action Submittals:

.1 Product Data: Submit one copy of product data for each type of product specified.

.2 Shop Drawings: Submit shop drawings indicating:

.1 Location of seams and edges

.2 Location of columns, doorways, enclosing partitions, built-in furniture, cabinets, and cut-out locations

.3 Type and style of resilient transition strip used between adjacent flooring types

.3 Samples for Verification:

.1 Resilient Flooring: Submit minimum 150 mm x 150 mm size samples of each different specified product for verification of colour and pattern tile material. Submit minimum 300 mm long samples for resilient accessories.

.2 Informational Submittals: Provide the following submittals during the course of the work:

.1 Site Quality Control Test Results: Submit results or moisture emission testing of concrete subfloors prior to installation of flooring. Results shall include comparison of manufacturer's recommended moisture content to actual moisture vapour emission rate.

.3 Maintenance Data and Operating Instructions:

.1 Operation and Maintenance Data: Submit manufacturer's written instructions for maintenance and cleaning procedures, include list of manufacturer recommended cleaning and maintenance products, and name of original installer and contact information.

.4 Safety Data Sheets:

.1 Submit WHMIS safety data sheets for incorporation into the Operation and Maintenance Manual. Keep one copy of WHMIS safety data sheets on site for reference by workers.

.5 Maintenance Materials:

.1 Provide 5% of each colour of vinyl composition tile and 10 m length coil stock of each colour of resilient base specified, boxed and labelled.

.2 Store maintenance materials on the premises as directed by the City.

.6 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentation for the following:

.1 Materials & Resources:

.1 MR Credit 4 - Recycled Content: 10% (post-consumer + ½ pre-consumer)

.2 Credit MR 6 - Rapidly Renewable Materials: Products must have content that is made from plants that are typically harvested within a 10 year cycle or shorter for 2.5% of the total value of all building materials and products used in the project

.2 Indoor Environmental Quality

.1 EQ Credit 4.1 - Low-Emitting Materials: Adhesives & Sealants.

1.6 QUALITY ASSURANCE

.1 Contractor executing work of this Section shall have a minimum of five (5) years continuous Canadian experience in successful and installation of work of type and quality shown and specified. Submit proof of experience upon Contract Administrator's request.

.2 Resilient Flooring Installer: Use an installer who is competent in heat welding and have a minimum of five (5) years documented experience in the installation of resilient sheet flooring and seams in accordance with manufacturer's training or certification program:

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with Construction Schedule and arrange ahead for off-the-ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store material in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

.4 Restrict traffic by other trades during installation.

.5 Provide adequate protection of completed tiled surfaces to prevent damage by other trades until final completion of this project. Minimum protection shall consist of kraftpaper.

1.8 ENVIRONMENTAL CONDITIONS

.1 Temperature of room, floor surface and materials shall not be less than 21 deg C for 48 hours before, during and for 48 hours after installation. Concrete floors shall be aged for a minimum of 28 days and shall be dry before application of the resilient floor tile.

.2 Moisture content of floor shall not exceed a maximum of 0.015 kgf/m² (3 lb/1000 sq.ft.) of water of concrete slab area over a 24 hour period as measured by one of the following methods, as approved by Contract Administrator:

.1 Rubber Manufacturer's Association (RMA) moisture test using anhydrous calcium chloride.

.2 Does not exceed 3% as measured by Calcium Carbide Hygrometer procedure.

.3 Does not exceed 5% as measured by normal Protimeter.

.3 Avoid exposure to high humidity, cold drafts and abrupt temperature changes.

1.9 WARRANTY

.1 Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions but for an extended period of five (5) years and agree to repair or replace faulty materials or work which become evident during warranty period without cost to the City. Defects shall include, but not limited to, bond failure, and extensive colour fading.

2 Products

2.1 MANUFACTURERS

.1 Specified Products: Work of this Section is based on products manufactured by Tarkett North America. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

.1 Other Acceptable Manufacturers:

.1 Armstrong Flooring

2.2 TILE FLOORING MATERIALS

.1 Vinyl Composition Floor Tile (VCT): ASTM F1066, Class 2, asbestos free uniform in thickness with uniform colour and pattern through the full thickness, with straight, sharp and square edges and corners. VCT II by Tarkett North America.

.1 Refer to Finishes Schedule for size and colour requirement.

.2 Rubber Tile (RBT): ASTM F1344, Class I, homogeneous composition of 100% synthetic rubber. Johnsonite Mesto Configurations by Tarkett North America.

.1 Refer to Finishes Schedule for size and colour requirement.

.3 Static Dissipative Tile (VSDT): ASTM F1700, Class I, Type A, Polyvinyl chloride resin, and installed as a system SDT yields an electrical resistance which meets ASTM F-150 for point to point and point to ground. iQ Granit SD by Tarkett North America.

.1 Refer to Finishes Schedule for size and colour requirement.

2.3 RESILIENT ACCESSORIES

.1 Wall Base: ASTM F1861, buffed exposed face, supplied in maximum practical length, with pre-moulded end stops and external corners to match base.

.1 Resilient Vinyl Base (RVB): Toe cove base, Johnsonite Traditional Vinyl by Tarkett North America.

.1 Refer to Finishes Schedule for size and colour requirement.

.2 Resilient Rubber Base (RBB): Toeless base, Johnsonite Thermoset Rubber by Tarkett North America.

.1 Refer to Finishes Schedule for size and colour requirement.

.2 Trowellable Levelling and Patching Compounds: Latex modified, portland cement based formulation provided or approved by resilient product manufacturer for applications indicated; Gypsum based materials will not be accepted for use on this project.

.3 Fillers and Primers:

.1 Types and brands approved, acceptable to flooring material and resilient base manufacturers for the applicable conditions. Use non-shrinking latex compound.

.4 Resilient Floor Tile Adhesive:

.1 Standard Tile: Waterproof, clear setting type and brands as recommended by resilient flooring manufacturer.

.2 Static Dissipative Tile: Acrylic polymer adhesive, and copper grounding strips, as recommended by resilient flooring manufacturer. Basis of Design Product: 906 Conductive Adhesive by Tarkett North America.

.5 Sealer and Wax: Coordinated with the City preferred long term maintenance program, sealer or wax as appropriate to flooring materials specified. Use products as recommended by resilient flooring manufacturer.

3 Execution

3.1 EXAMINATION

.1 Testing of Sub-Floors: Test floors that have been cured for minimum 28 days, and after preparation for Product installation is complete. Conduct testing simultaneously on floors free of sealer, curing compounds, oil, grease and other agents detrimental to the test and the Product performance, and in strict conformance with test kit manufacturer's written instructions. Locate test sites to cover representative installation areas. Do not proceed with work when the test results do not conform to the specified allowable.

.1 Moisture Vapour Emission: Test floors to ASTM F1869 using anhydrous calcium chloride method. Provide 3 test sites for floor area up to 93 sq.m. (1000 sq.ft.), add one test site for each additional 93 sq.m. (1000 sq.ft.) or fraction thereof.

.1 Vinyl Composition Tiles: Maximum moisture content of 2.27 kg/93 sq.m. (5 lbs/1000 sq.ft.) per 24 hour.

.2 Alkalinity: Acceptable range of 5 to 9 on the pH scale. Test floors using distilled water and pH paper. Provide 2 tests for every moisture vapour emission test.

.2 Examine substrates, areas, and conditions affecting work are in accordance with manufacturer's requirements, and as follows:

.1 Verify that floor surfaces are smooth and flat to plus or minus 3 mm (1/8”) over 3050 mm (10’); notify Contract Administrator in writing where floor tolerances are not within acceptable values.

.2 Verify that concrete slabs exhibit normal alkalinity of between 5 and 9 and that they are free of carbonization or dusting deleterious to flooring installation or adhesive bond.

.3 Verify that subfloors are free of cracks, ridges, depressions, scale, and foreign deposits that could interfere with flooring installation.

3.2 PREPARATION

.1 Comply with resilient flooring manufacturer's written installation instructions for preparing substrates indicated to receive flooring.

.2 Fill cracks, holes, and depressions in substrates using trowellable levelling and patching compounds in accordance with manufacturers written instructions and as follows:

.1 Levelling and patching shall be restricted to correcting minor deviations or imperfections to bring floor surface finish to within flooring manufacturers tolerances for flatness.

.3 Remove coatings from concrete substrates, including curing compounds and other substances that are incompatible with flooring adhesives, and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer; do not use solvents.

.4 Broom and vacuum clean substrates immediately before installing flooring.

3.3 INSTALLATION

.1 Comply with resilient flooring manufacturer's written installation instructions.

.2 Unroll flooring and allow stabilizing before cutting and fitting in accordance with manufacturer’s installation instructions.

.3 Apply primer in strict accordance with manufacturer's printed instructions. Permit primer to dry.

.4 Apply adhesive uniformly with an approved notchtooth spreader at the recommended rate. (Mechanical spreader not approved). Do not spread more adhesive than can be covered before initial set takes place. Use waterproof adhesive throughout. Follow manufacturer's instructions.

.5 Layout tile flooring as follows:

.1 Lay tile with joints parallel to building lines to produce a symmetrical tile pattern.

.2 Install tile flooring so that perimeter tile width is minimum 1/2 full size.

.6 Layout resilient base as follows:

.1 Fit joints tight and vertical.

.2 Joints along one plane shall be at minimum 23’ spacing, at inconspicuous locations.

.3 Mitre internal corners, use pre-moulded sections for external corners and exposed ends.

.4 Install base on solid backing. Adhere tightly to wall and floor surfaces.

.5 Scribe and fit to door frames and other obstructions.

.6 Install outside corners prior to installation of straight sections.

.7 Install straight and level to variation of plus or minus 3 mm (1/8") over 3050 mm (10’) straight edge.

.8 Do not stretch base during installation.

.9 Shave back of base where necessary to produce snug fit to substrate.

.10

.7 Accurately scribe tile around walls, and other floor conditions.

.8 Each type of material used shall be from one manufacturer throughout the work and material in each area shall be of same production run.

.9 Remove and replace loose, damaged and defective tiles where required and as directed by Contract Administrator.

3.4 CLEANING, SEALING AND FINISHING

.1 Cleaning, sealing and finishing of resilient tile flooring shall be performed using the cleaning, sealing and finishing materials specified of one manufacturer in accordance with the manufacturer's instructions and recommendations. Allow a minimum of four (4) days to elapse after completion of each resilient flooring installation before commencing cleaning, sealing, and finishing operations.

.2 Work shall be handed over to the City free of blemishes and in perfect condition.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This section includes material for application of epoxy flooring, including surface preparation, primer, aggregate topping, grout coat, and finish coat.

.2 All work required to result in a first-class installation for the City's intended use. No substitution of materials or installation methods will be accepted.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 QUALITY ASSURANCE

.1 Installer: Trained and approved by the manufacturer and having a minimum three years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type.

.2 Maintenance Seminars: Engage a factory authorized service representative to train City's maintenance personnel on proper maintenance procedures.

.3 Pre-Installation Meeting: Prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.4 Manufacturer's Site Inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.5 Testing of Concrete Floors: Test floors that have been cured for minimum 28 days, and after preparation for Product installation is complete and patching or levelling compound is fully cured. Conduct testing simultaneously on floors free of sealer, curing compounds, oil, grease and other agents detrimental to the test and Product performance. Locate test sites evenly to cover representative installation areas. Do not proceed with work when the test results do not conform to the specified allowable.

.1 Cohesive Strength: Minimum 1.45 MPa (210 psi) by tensile load as tested to CSA A23.2-6B. Do one test for every 9 sq.m. (1000 sq.ft.) or fraction thereof.

.2 Moisture Vapour Emission: Maximum moisture content of 1.36 kg/93 sq.m. (3 lbs/1000 sq.ft.) per 24 hour as tested to ASTM F1869 using anhydrous calcium chloride method. Provide 3 test sites for floor area up to 93 sq.m. (1000 sq.ft.), add one test site for each additional 93 sq.m. (1000 sq.ft.) or fraction thereof.

.3 Surface Moisture Content: Maximum 4%, tested by moisture meter. Do one test for every 4.5 sq.m. (500 sq.ft.) or fraction thereof.

.4 Surface Temperature: Minimum 3 degree C above the measured dew point.

.6 Coordination: Coordinate work of this Section with work of Division 9 Epoxy Wall Coatings. Ensure compatibility of floor and wall finish products where they come into contact. Coordinate installation to provide neatly finished overlap where floor and wall coatings meet.

1.5 SUBMITTALS

.1 Product Data: Submit manufacturer's technical data, installation instructions and general recommendations for each type of flooring material required.

.2 Samples: Submit 300 mm x 300 mm (12" x 12") sample of flooring for approval. Submit additional samples until approval is obtained. Make changes in aggregate mix as required to secure correct colour and texture. Label sample(s) with Project name and number, applicator, names of material and manufacturer, colour, gloss, texture and aggregate mix proportion.

.3 Safety Data Sheets:

.1 Submit WHMIS safety data sheets for inclusion with project record documents. Keep one copy of WHMIS safety data sheets on Site for reference by workers.

.4 Maintenance Instructions:

.1 Upon completion of the Work, furnish Contract Administrator with copies of maintenance instructions, containing complete detailed and specific instructions for maintaining, preserving and keeping clean the surfaces of this Work and in particular, giving adequate warning of maintenance practices of materials detrimental to the work of this Section for inclusion in the Operation and Maintenance Manual.

.5 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentation in accordance to the following:

.1 Indoor Environmental Quality:

.1 EQ Credit 4.2 - Low-Emitting Materials: Paint and Coatings

1.6 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store material in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

.4 Store flammable materials in safe, approved containers to eliminate fire hazards and remove from Site at end of each work shift.

.5 Do not use materials that has been stored for period of time exceeding maximum recommended shelf life of materials.

1.7 PROJECT CONDITIONS

.1 Maintain minimum air and surface temperatures at 16 deg C for 24 hours before, during, and for 48 hours following application, or until cured.

.2 Maintain well-lit and well-ventilated area.

.3 Comply with flooring manufacturer's directions for maintenance of substrate temperatures, ventilation and other conditions required to execute and protect work.

1.8 PROTECTION

.1 Protect adjacent surfaces from damage resulting from work of this Section. If necessary, cover or mask adjacent surfaces to those receiving flooring including fixtures and equipment.

.2 Replace materials soiled during application, and from which soil cannot be completely removed, at no extra cost.

.3 Ensure that spark-proof electrical equipment is used in areas where inflammable materials are being applied. Prevent use of open flames or equipment that may cause sparks.

1.9 WARRANTY

.1 Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions, but for a period of two (2) years, and agree to promptly make good defects which become evident during the warranty period without cost to the City. Defects shall include but not be limited to the following; cracking, crazing, discolouration, staining.

2 Products

2.1 GENERAL

.1 All components and products of the epoxy flooring system shall be manufactured and supplied by a single manufacturer, to ensure compatibility between components.

2.2 MATERIALS

.1 Epoxy Floor Coating: Two components, 100% solid, low VOC, low odour; coating and sealer; slip-resistant finish; standard colour.

.1 Acceptable Products:

.1 Epoxal 100WH by Niagara Protective Coatings.

.2 Stonkote GS4 by Stonhard Limited.

.3 FastFlor CR by Sika.

.2 Moisture Barrier, Slab-on-Grade: Coating manufacturer's standard, to reduce moisture transmission to 1.36 kg/93 sq.m. (3 lbs/1000 sq.ft.).

.3 Primer: As recommended by manufacturer supplying flooring material for types of surface to be primed.

.4 Subfloor Filler: Compatible to floor coating and as recommended by coating manufacturer.

.5 Joint Backing: Preformed, compressible strips of closed cell polyethylene or urethane foam, rubber tubing or non-migrating plasticized vinyl, oversized 25%, compatible with sealant, primer, epoxy surfacing and substrate.

.6 Joint Sealant: ASTM C920, Type M, Grade P, Class 25, Use T, multi component modified urethane base chemical curing; material compatible with floor finish and as recommended by flooring manufacturer.

3 Execution

3.1 EXAMINATION

.1 Examine surfaces and conditions under which flooring is to be applied. Moisture content of surfaces and building air temperatures must be within limits recommended by the flooring manufacturer. Do not start work until unsatisfactory conditions have been corrected. Application of materials indicates acceptance of surfaces.

.2 Surfaces shall be free of membrane curing compounds, laitance, dust, dirt, grease, oil and other contaminants that may affect proper adhesion of the coating.

.3 Do not apply coating system if ambient temperature is below 10 deg C (50 deg F) or above 32 deg C (90 deg F) or if relative humidity is above 80%.

3.2 SURFACE PREPARATION

.1 Remove projections and other conditions that may affect the installation of the flooring system.

.2 Protect adjacent surfaces, fixtures and equipment with drop cloths or masking as necessary to prevent damage from surface preparation.

3.3 INSTALLATION

.1 Mix and apply work in strict accordance manufacturer's printed directions in specified thickness, with integral cove bases, uninterrupted except at sawn joints or other types of joints required, free of laps, pin holes, voids, crawls, skips or other marks or irregularities are visible, and to provide uniform appearance.

.2 Work coating into corners and other restricted areas, up and over bases, and into recesses in floors to ensure full coverage.

.3 Make clean true junctions with no visible overlap between adjoining applications of coatings.

.4 Moisture Barrier: Apply moisture barrier coating on prepared slab-on-grade substrate before primer application, to manufacturer’s instruction.

.5 Primer: Apply primer over prepared substrate, at manufacturer's recommended spreading rate with timing of application co-ordinated with subsequent application of topping mix to ensure optimum adhesion between flooring materials and substrate.

.6 Finish coats: Apply minimum of two finish coats at spreading rate recommended by manufacturer to achieve minimum total thickness of 0.5 mm (0.020”) DFT. Allow minimum recommended drying time between coats.

.1 Base Coat: Apply base coat and immediately broadcast aggregates and back roll to obtain slip-resistant texture finish. Let dry.

.2 Top Coat: Apply top coat to dry base coat for consistent appearance.

.7 Cove Base: Provide 150 mm(6") high cove base struck straight to provide line for wall finish.

3.4 CLEANING AND FINISHING

.1 Touch up and refinish minor defects in work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.

.2 Remove promptly as work progresses spilled or splattered coating materials from adjacent surfaces. Clean floors on completion of Work. Do not mar surfaces while removing splatters.

.3 Protect completed work from traffic for at least one week to allow proper curing of floor finish. Protect work from any trades using area after completion of installation.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This section includes material for trowel application of epoxy flooring, including surface preparation, primer, aggregate topping, grout coat, and finish coat.

.2 All work required to result in a first class installation for the intended use. No substitution of materials or installation methods will be accepted.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 QUALITY ASSURANCE

.1 Installer: Trained and approved by the manufacturer and having a minimum three years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type.

.2 Maintenance Seminars: Engage a factory authorized service representative to train the City's maintenance personnel on proper maintenance procedures.

.3 Pre-installation meeting: Prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.4 Manufacturer's site inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.5 Testing of Concrete Floors: Test floors that have been cured for minimum 28 days, and after preparation for Product installation is complete and patching or levelling compound is fully cured. Conduct testing simultaneously on floors free of sealer, curing compounds, oil, grease and other agents detrimental to the test and Product performance. Locate test sites evenly to cover representative installation areas. Do not proceed with work when the test results do not conform to the specified allowable.

.1 Cohesive Strength: Minimum 1.45 MPa (210 psi) by tensile load as tested to CSA A23.2-6B. Do one test for every 9 sq.m. (1000 sq.ft.) or fraction thereof.

.2 Moisture Vapour Emission: Maximum moisture content of 1.36 kg/93 sq.m. (3 lbs/1000 sq.ft.) per 24 hour as tested to ASTM F1869 using anhydrous calcium chloride method. Provide 3 test sites for floor area up to 93 sq.m. (1000 sq.ft.), add one test site for each additional 93 sq.m. (1000 sq.ft.) or fraction thereof.

.3 Surface Moisture Content: Maximum 4%, tested by moisture meter. Do one test for every 4.5 sq.m. (500 sq.ft.) or fraction thereof.

.4 Surface Temperature: Minimum 3 degree C above the measured dew point.

.6 Coordination: Coordinate work of this Section with work of Division 9 Epoxy Wall Coatings. Ensure compatibility of floor and wall finish products where they come into contact. Coordinate installation to provide neatly finished overlap where floor and wall coatings meet.

1.5 SUBMITTALS

.1 Product data: Submit manufacturer's technical data, installation instructions and general recommendations for each type of flooring material required.

.2 Samples: Submit 300 mm x 300 mm (12" x 12") sample of flooring for approval. Submit additional samples until approval is obtained. Make changes in aggregate mix as required to secure correct colour and texture. Label sample(s) with Project name and number, applicator, names of material and manufacturer, area where material will be applied, date of sample, colour, gloss, texture and aggregate mix proportion.

.3 Safety Data Sheets:

.1 Submit WHMIS safety data sheets for inclusion with project record documents. Keep one copy of WHMIS safety data sheets on Site for reference by workers.

.4 Maintenance Instructions:

.1 Upon completion of the Work, furnish Contract Administrator with copies of maintenance instructions, containing complete detailed and specific instructions for maintaining, preserving and keeping clean the surfaces of this Work and in particular, giving adequate warning of maintenance practices of materials detrimental to the work of this Section for inclusion in the Operation and Maintenance Manual.

.5 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentation in accordance to the following:

.1 Indoor Environmental Quality:

.1 EQ Credit 4.2 - Low-Emitting Materials: Paint and Coatings

1.6 SAMPLE INSTALLATION

.1 At Site, in area designated by Contract Administrator, erect sample floor area of 1 sq.m (10 sq.ft.) for each type of flooring, including waterproofing membrane, primer and necessary number of coats to obtain specified finish, showing colour range, bond and quality of work. Erect additional sample, if required, to obtain approval. Approved samples shall become standard of comparison for flooring work on Site and shall not be destroyed or moved until authorized by Contract Administrator.

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store material in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

.4 Store flammable materials in safe, approved containers to eliminate fire hazards and remove from Site at end of each work shift.

.5 Do not use materials that has been stored for period of time exceeding maximum recommended shelf life of materials.

1.8 PROJECT CONDITIONS

.1 Maintain minimum air and surface temperatures at 16 deg C (60 deg F) for 24 hours before, during, and for 48 hours following application, or until cured.

.2 Maintain well-lit and well-ventilated area.

.3 Comply with flooring manufacturer's directions for maintenance of substrate temperatures, ventilation and other conditions required to execute and protect work.

.4 Protect adjacent surfaces from damage resulting from work of this Section. If necessary, cover or mask adjacent surfaces to those receiving flooring including fixtures and equipment.

.5 Materials soiled by coatings during application and storage, and from which soil cannot be completely removed, shall be replaced by this Section at no extra cost.

.6 Erect barriers to prevent entry and presence of workers not performing work of this Section during application of flooring and for 48 hours following completion of application.

1.9 WARRANTY

.1 Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions, but for a period of two (2) years, and agree to promptly make good defects which become evident during the warranty period without cost to the City. Defects shall include but not be limited to the following; cracking, crazing, discolouration, staining.

2 Products

2.1 GENERAL

.1 All components and products of the epoxy flooring system shall be manufactured and supplied by a single manufacturer, to ensure compatibility between components.

2.2 MATERIALS

.1 General: Materials used in application of each flooring system shall be of same manufacturer and same supplier.

.2 Epoxy Flooring (light to medium traffic):

.1 100% solids, no VOC, no odour; multicoat system consisting of 2-component epoxy primer, trowel applied epoxy matrix (coloured resin, silica aggregates) and 2 coats clear epoxy/epoxy grout; minimum 6 mm (1/4”) total thickness; slip-resistant finish; colour to be selected by Contract Administrator from manufacturer's standard range.

.2 Acceptable Products:

.1 Sikafloor Morritex Trowel System by Sika Canada.

.2 Kromotex SLD by Niagara Protective Coatings.

.3 Stonclad GS by Stonhard Ltd.

.3 Primer: as recommended by manufacturer supplying flooring material for type(s) of surface to be primed.

.4 Divider Strips: 'L' shape to required floor thickness, white alloy zinc.

.5 Cove strips: as recommended by flooring manufacturer.

.6 Joint Backing: preformed, compressible strips of closed cell polyethylene or urethane foam, rubber tubing or non-migrating plasticized vinyl with shore 'A' hardness of 20 and tensile strength between 140 kPa and 200 kPa. Sizes and shapes to suit various conditions, diameter 25% greater than joint width. Compatible with sealant, primer, epoxy flooring and substrate.

.7 Joint Sealant: ASTM C920, multicomponent modified urethane base, chemical curing; material compatible with floor finish and as recommended by flooring manufacturer.

3 Execution

3.1 EXAMINATION

.1 Ensure that concrete slab has been properly cured and dry for minimum of 28 days.

.2 Ensure that slab on grade has been adequately waterproofed beneath and at perimeter of slab and on earth side of below grade walls.

.3 Ensure that no curing and sealing compounds, hardeners or other chemical additives have been used on concrete.

.4 Verify that specified environmental conditions are maintained before commencing work. Be familiar with manufacturer's product literature and Material Safety Data Sheets and comply with precautions, handling procedures and equipment requirements.

.5 Report concrete floor test results to Contract Administrator and obtain manufacturer's representative's approval before proceeding.

.6 Do not start work until unsatisfactory conditions have been corrected. Commencement of work indicates acceptance of all surfaces and conditions.

3.2 PREPARATION

.1 Clean subfloor free of laitance, oil, grease and other foreign matter detrimental to flooring application.

.2 Prepare existing and new concrete floors over entire area with steel shot blasting or other method recommended by manufacturer. Remove uneven joints, rough areas, foreign and projection off surfaces. Surface to be hard, sound, and roughened to irregular surface with weak concrete removed and surface holes and voids exposed. Equip dry blasting machine with vacuum to minimize dust.

.3 Repair cracks, holes or other deficiencies in accordance with manufacturer's recommendations.

.4 Blow clean control joints, sawcuts and cracks with compressed air and grout with material compatible with floor coating materials.

.5 Ensure that masonry backing surfaces for cove bases are free of voids and irregularities. Fill recessed joints with recommended epoxy plaster.

.6 Obtain Contract Administrator’s approval of prepared substrate before installation of flooring.

3.3 INSTALLATION

.1 Prepare, mix materials and apply each component of flooring system in strict accordance with manufacturer's printed directions to produce uniform monolithic wearing surface of thickness indicated for each system, with integral cove bases, uninterrupted except at divider strips, sawn joints or other types of joints required.

.2 Apply flooring with care to ensure that no laps, pin holes, voids, crawls, skips or other marks or irregularities are visible, and to provide uniform appearance.

.3 Work coating into corners and other restricted areas, up and over equipment bases, and into recesses in floors to ensure full coverage.

.4 Make clean true junctions with no visible overlap between adjoining applications of coatings.

.5 Match approved sample for colour, sheen, texture and slip resistance.

.6 For large areas, stop each day's production at metal dividing strip at lines approved by Contract Administrator.

.7 Primer: Apply primer over prepared substrate, at manufacturer's recommended spreading rate with timing of application coordinated with subsequent application of topping mix to ensure optimum adhesion between flooring materials and substrate.

.8 Trowel Applied Epoxy Matrix: Combine aggregate to blended epoxy resin to form trowellable mortar. Trowel apply mix over tacky primer in number of coats and at spreading rates required to produce minimum thickness specified. Allow topping to harden minimum time recommended by manufacturer before applying finish coats.

.9 Epoxy/Epoxy Grout Top Coats: When trowelled epoxy matrix has hardened, remove imperfections by lightly abrading surface and vacuum clean. Apply 2 finish coats at spreading rate and following method recommended by manufacturer to achieve 0.254 mm (10 mils) minimum thickness and to obtain specified finish to match approved samples. Allow minimum recommended drying time between coats.

.10 Cove Bases: Terminate base 150 mm (6") high, feather out and trim evenly along wall to provide smooth transition with adjacent wall finish. Ensure top coat is compatible with wall coating prior to application. Round interior and exterior corners.

.11 Thresholds:

.1 Where flooring terminates at doorways, and difference in height occurs between seamless flooring and other finishes, install tapered aluminium thresholds not less than 25 mm (1") wide and full thickness of difference in level.

.2 Where flooring terminates at doorways, and floor finishes are of same thickness, provide metal divider strips flush with surfaces.

.12 Floor Drains: Slope flooring to drains minimum of 1:100 from furthest surface point. Grind concrete around perimeter to provide 6 mm (1/4") thickness of flooring material which is flush with top of drain and slopes as indicated on Drawings.

.13 Ramps, Stairs and Landings: Provide textured slip resistant finish to surfaces of ramps stairs and landings. Finish stair nosing in accordance with manufacturer's recommendations. Match approved sample.

.14 Chasing: Provide chase where flooring does not abut against vertical surface by chiselling out 38 mm (1-1/2") wide chase to straight saw-cut 12 mm (1/2") depth.

.15 Control Joints: Where substrate is interrupted by isolation, control or expansion joints, provide saw-cut joint in flooring after floor installation, install backer rod and fill with manufacturer's recommended epoxy or urethane sealant.

3.4 ADJUSTMENT AND CLEANING

.1 Touch up and refinish minor defects in work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.

.2 Remove promptly as work progresses spilled or splattered coating materials from adjacent surfaces. Clean floors on completion of Work. Do not mar surfaces while removing splatters.

.3 Protect completed work from traffic for at least 7 days to allow proper curing of floor finish. Protect work from any trades using area after completion of installation.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation for tile carpeting.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 American Society for Testing and materials (ASTM):

.1 ASTM F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

.2 ASTM F1869, Standard Test method for measuring moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

.3 Carpet and Rug Institute (CRI), as endorsed by the Canadian Carpet Institute (CCI):

.1 CRI Installation Technical Bulletins

.2 CRI Green Label Program

.4 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Install carpeting before installing items indicated for installation on top of carpet and after other finishing operations, including painting and ceiling construction, has been completed.

.2 Pre-installation Conference: Conduct conference at Project site, to verify project requirements, substrate conditions, patterns and layouts, coordination with other Sections affected by work of this Section, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: Use only carpeting materials that have been tested and accepted for labelling under ULC S102.2 and meeting requirements of the Authority Having Jurisdiction.

.2 Installer: Trained and approved by the manufacturer and having a minimum three years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.

.3 Maintenance Seminars: Engage a factory authorized service representative to train the City's maintenance personnel on proper maintenance procedures.

.4 Manufacturer's Site Inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.5 Source Limitations: Obtain each type of product from a single manufacturer.

.6 Products: Provide like Products from same production run. Install Products in sequence from sequentially numbered dye lots.

.7 Testing of Concrete Floors: Test floors that have been cured for minimum 28 days, and after preparation for Product installation is complete. Conduct testing simultaneously on floors free of sealer, curing compounds, oil, grease and other agents detrimental to the test and the Product performance, and in strict conformance with test kit manufacturer's written instructions. Locate test sites to cover representative installation areas. Do not proceed with work when the test results do not conform to the specified allowable.

.1 Moisture Vapour Emission, Slabs-On-Grade: Maximum 1.36 kg (3 lbs) of moisture per 93 sq.m.(1000 sq.ft.) per 24 hour. Test floors to ASTM F1869 using anhydrous calcium chloride method. Provide 3 test sites for floor area up to 93 sq.m. (1000 sq.ft.), add one test site for each additional 93 sq.m. (1000 sq.ft.) or fraction thereof.

.2 Alkalinity, Slabs-On-Grade: Acceptable range of 5 to 9 on the pH scale. Test floors using distilled water and pH paper or pH pencil. Provide 2 tests for every moisture vapour emission test.

1.6 SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's standard product data indicating requirements for installation.

.2 Samples: Submit samples of each type of tile carpeting and adhesive required for the project for confirmation of project requirements.

.1 Submit full size pieces of each type of carpet tiles for review.

.2 Submit 300 mm (12") long samples of edge strip.

.2 Informational Submittals: Provide the following submittals during the course of the work:

.1 Certificates: Submit proof of performance for each material specified in this Section as follows:

.1 Indoor Air Quality (IAQ): Confirmation of participation in Carpet and Rug Institute's Carpet Testing Program requirements including certificate number including expiration date; or participation certificate indicating participation in ISO 14001 Registration or Scientific Certification System.

.2 Site Quality Control Test Results: Submit results or moisture emission testing of concrete subfloors prior to installation of flooring. Results shall include comparison of manufacturer's recommended moisture content to actual moisture vapour emission rate.

.3 Sustainable Design Submittals:

.1 Submit documentation in accordance with the following:

.1 Adhesive certified for low VOC emissions in compliance with the California Department of Public Health (CDPH) 01350 Standard.

.2 Certificates to prove the material is certified to the following:

.1 Cradle to Cradle Silver

.2 Green Label Plus to indoor air quality

1.7 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit manufacturer's written instructions for maintenance and cleaning procedures, include name of original installer and contact information as follows:

.1 Detailed printed instructions for maintenance procedures to ensure maximum life and appearance of floor covering

.2 Information on recycling of tile carpeting including manufacturer's reprocessing program; indicate what portions of materials are recyclable

.2 Maintenance Materials: Provide extra materials that match installed products; packaged with protective covering for storage, and identified with labels describing contents as follows:

.1 Tile Carpeting Materials: 5% of total installation with a minimum of 2 boxes of each colour and type.

.2 Tile Carpeting Accessories: 5% of total installation with a minimum length of 3050 mm of each colour and type

1.8 WASTE MATERIAL RECLAMATION/RECYCLING

.1 Collect, package and store carpet cut-offs and waste material for recycling in accordance with manufacturer's reclamation program. Include cost in the Contract Price.

.2 Submittals:

.1 Manufacturer's description of reclamation and recycling process to recycle recovered carpets.

.2 Information on recycling carpet and indicate which portions of carpet are recyclable.

.3 Evidence that removed carpet has been transferred to manufacturer's reclamation program.

1.9 SITE CONDITIONS

.1 Ambient Conditions: Maintain temperature and ventilation in work area using permanent heating system, and portable supply and exhaust fans in accordance with manufacturer's requirements and as follows:

.1 Install Tile Carpeting when wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for project when occupied for its intended use.

.2 Install Tile Carpeting over concrete subfloor once slabs have cured and are sufficiently dry to bond with adhesive and concrete subfloor have pH range recommended by carpet manufacturer.

1.10 WARRANTY

.1 Joint and Several Warranty: Notwithstanding the 12 months warranty period specified in the General Conditions of Contract, the carpet manufacturer's warranty specified in this Section is extended to a period of ten (10) years from date of Substantial Performance.

1.11 SAMPLE INSTALLATION

.1 Provide a 3 m x 3 m (10' X 10') representative sample installation of work of this Section on site at location directed by Contract Administrator to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation. Remove rejected sample installation and provide additional sample installations until acceptance is given. Do not commence work until sample installation has been accepted. Accepted sample installation may form part of the completed Work if undisturbed at time of Substantial Performance.

.2 Acceptance of sample installations does not constitute approval of deviations from the Contract Documents contained in sample installations unless such deviations are specifically approved by Contract Administrator in writing.

2 Products

2.1 MANUFACTURERS

.1 Specified Product: Work of this Section is based on products specified. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

2.2 MATERIALS

.1 Tile Carpeting: As selected by Contract Administrator from manufacture standard products line.

.2 Flammability: CGSB 4-GP-129 and other requirements of authorities having jurisdiction.

.3 Antimicrobial: AATCC 174, 99% reduction, 0% growth; incorporated into the backing laminate to inhibit the growth of fungi, mould and mildew.

.4 Carpet Tiles: Refer to Finishes Schedules for colour, type and size requirements

2.3 ACCESSORIES

.1 Carpet Tile Adhesives and Primers: As recommended by the carpet manufacturer, pressure sensitive. non-flammable and non-water soluble when dry.

.2 Resilient Wall Bases and Edge Trims:

.1 Refer to Sections 09 05 00 and 09 65 00 for profile, material and installation requirements to protect exposed edge of carpet; maximum lengths to minimize running joints

.3 Sub-Floor Filler and Levelling Compound: White premix latex requiring water only to produce cementitious paste

3 Execution

3.1 EXAMINATION

.1 Examine the substrate over which work is to be installed. Report unacceptable work immediately. Do not commence work until defects have been corrected.

.2 Surfaces to receive work shall be dry and clean. Examine concrete for evidence of excessive carbonation and dusting.

.3 Remove oil, grease, paint, sealers and other material detrimental to installation.

.4 If a curing membrane has been used on the concrete, ascertain its compatibility with the adhesive and subfloor filler. If incompatible, remove it by approved methods.

.5 Grind ridges and high spots smooth and flush, fill and level cracks and depressions with subfloor filler.

.6 Vacuum substrates prior to carpet installation.

.7 Maintain material and ambient temperature at minimum 15 deg C for 24 hours before, during and after installation.

3.2 INSTALLATION - GENERAL

.1 Install in accordance with manufacturer's printed instructions using material from same dye lot; mix materials to obtain consistent colour, pattern and texture match within any one visual area.

.2 Install carpet after other finishing Sections have completed their work.

.3 For large areas, commence installation near centre of area and work outward.

.4 Instruct other Sections as to clearances at the bottom of door frames and elsewhere as required for proper carpet installation.

.5 Where carpet is joined or stopped at doorways, locate the seam or edge moulding, as applicable, under the door in its closed position.

.6 Neatly scribe and cut carpet at adjacent vertical surfaces and around appurtenances occurring in the floor.

.7 Install carpet into access and cleanout covers where such are provided with a recess to receive floor finish materials.

.8 Ensure that single and continuous areas are carpeted with material of the same dye batch. Ensure that any apparent direction of pile or pattern is the same on all widths.

.9 Completed Work: Flat and even, free of ripples, air bubbles and other defects.

.10 Butter cut edges during installation with liquid latex to prevent unravelling.

.11 Provide metal carpet edge moulding where carpet meets other floor finish unless otherwise indicated.

.12 Make cuts from back, using template for fitting around columns or at room perimeter.

.13 Restrict traffic during installation. Upon completion of installation, do not allow traffic or movement of furniture onto carpet surface until installed area has been anchored at perimeter.

3.3 INSTALLATION – CARPET TILE

.1 Install carpet tiles to achieve monolithic appearance with arrows on back pointing in same direction.

.2 Commence work in centre of area. Accurately lay chalk lines in the length and width of area.

.3 Lay row of control tiles in adhesive along centre lines accurately and firmly in selected quadrant, in straight lines and square corners. Lay additional tiles within quadrant by stair step technique.

.4 Measure areas to ensure tight installation. Measure over 11 tiles to attain cumulative space gained over 10 joints. The gain must not be greater than 6 mm. Utilize this method in continual check of installation.

.5 Frequently check tile joints for proper alignment. Do not install tiles that are out of true more than 1.5 mm.

.6 Avoid excessive pressure on joining tiles causing tiles to peak or buckle. Brush back face pile and tip tile into place to avoid any pile being caught in joint.

.7 Lay last whole tile closest to wall and perimeter cut tiles in adhesive. Accurately cut and tightly fit perimeter cut tiles against vertical fixed surface such as wall.

3.4 CLOSEOUT ACTIVITIES

.1 Clean-Up: Remove tile carpeting waste and debris from premises and leave installation clean after completion of carpeting operations in an area; protect finished areas from work following installation in accordance with manufacturer’s written instructions.

.2 On completion of installation, vacuum clean all carpeted areas.

.3 Repairs: Replace damaged or defective tile carpeting at no cost to the City.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Provide labour, materials, tools and other equipment, services and supervision required to complete interior and exterior, including above roof, painting and decorating work.

.2 Surface preparation for this section will be limited to priming and backpriming, and specific pretreatments noted in this section or as specified in the Master Painters Institute (MPI) Painting Specification Manual.

1.3 RELATED REQUIREMENTS

.1 Other sections of the specification requiring painting refer to this section. Coordinate requirements of referencing sections.

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.3 Environmental Choice Paints and Surface Coatings, Low VOC Product Listings Program (ECP):

.1 Paints and Surface Coatings, Low VOC Product Listings

.4 The Master Painters Institute (MPI):

.1 New Surfaces: Architectural Painting Specification Manual.

.5 The Society for Protective Coatings (SSPC):

.1 Coating Materials Guidelines

.2 Surface Preparation Guidelines

.3 Application, Inspection and Quality Control Guidelines

1.5 DEFINITIONS

.1 Gloss Levels: Standard coating terms defined by MPI Manual apply to products of this Section as follows:

.1 G1: Matte of Flat: Lustreless or matte finish with a gloss range below 10 when measured at 85° to meter and 0 to 5 when measured at 60°.

.2 G2: Velvet: Matte to low sheen finish with a gloss range of 10 to 35 when measured at 85° to meter and 0 to 10 when measured at 60°.

.3 G3: Eggshell: Low sheen finish with a gloss range of 10 to 35 when measured at 85° to meter and 10 to 25 when measured at 60°.

.4 G4: Satin: Low to medium sheen with a gloss range of minimum 35 when measured at 85° to meter and 20 to 35 when measured at 60°.

.5 G5: SemiGloss: Medium sheen finish with a gloss range of 35 to 70 when measured at 60° to meter.

.6 G6: Gloss: High sheen finish with a gloss range of 70 to 85 when measured at 60° to meter.

.7 G7: High Gloss: Reflective sheen having a gloss range in excess of 85 when measured at 60° to meter.

1.6 SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit list of all painting materials used for the Work to the Contract Administrator for review prior to ordering materials for each paint system indicated, including block fillers and primers.

.1 Material List: An inclusive list of required coating materials indicating each material and cross reference specific coating, finish system, and application; identify each material by manufacturer's catalogue number and general classification.

.2 Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

.2 Samples: Provide stepped samples, defining each separate coat, including block fillers and primers using representative colours required for the project; label each sample for location and application, and as follows:

.1 Drawdown Samples: Provide three (3) drawdown sample charts (cards) for each type, texture and colour of finish specified for verification purposes before ordering paint materials.

.3 Informational Submittals: Provide the following submittals when requested by the Contract Administrator:

.1 Certification: Submit certification reports for paint products indicating that they meet or exceed low VOC and coloured base requirements listed in this Section.

.2 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentation in accordance to the following:

.1 Indoor Environmental Quality:

.1 EQ Credit 4.2 - Low-Emitting Materials: Paint and Coatings:

.1 Documentation identifying that VOC content is less than the VOC limits of Green Seal Standards GS-11 for architectural paints, coating and primers applied to walls and ceilings.

1.7 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit copies of paint manufacturer’s written maintenance information for inclusion in the operations manual, including specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.

.2 Maintenance Materials: Deliver maintenance materials to the City in quantities indicated, that match products installed; packaged with protective covering for storage, and identified with labels describing contents and building location and as follows:

.1 Paints and Coatings: Minimum of four containers of 4-litres field colour paints and four containers of 1-litres each accent colour paints, and all remnants.

1.8 QUALITY ASSURANCE

.1 Conform to the standards contained in the MPI Manual.

.2 Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in service performance, and as follows:

.1 Have a minimum of five (5) years proven satisfactory experience and shall show proof before commencement of work that he will maintain a qualified crew of painters throughout the duration of the work.

.2 When requested provide a list of the last three comparable jobs including, name and location, specifying authority, start and completion dates and cost amount of the painting work.

.3 Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.

.3 Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats and as follows:

.1 Use only paint manufacturers and products as listed under the Approved Products section of the MPI Manual Architectural Painting Specification Manual.

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Conform to MPI Manual and manufacturers requirements.

.2 Perform no painting or decorating work when the ambient air and substrate temperatures, relative humidity and dew point and substrate moisture content is below or above requirements for both interior and exterior work.

.3 Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.

.4 Ensure adequate continuous ventilation and sufficient heating and lighting is in place.

.5 Paint, stain and wood preservative finishes and related materials (thinners, solvents, caulking, empty paint cans, cleaning rags, etc.) shall be regarded as hazardous products. Recycle and dispose of same subject to regulations of applicable authorities having jurisdiction.

.6 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground retain cleaning water and filter out and properly dispose of sediments.

.7 Set aside and protect surplus and uncontaminated finish materials not required by the City and deliver or arrange collection for verifiable re-use or re-manufacturing.

1.10 WARRANTY

.1 Special Warranty: Provide an MPI two (2) year guaranty, or a 100% two (2) year Maintenance Bond in accordance with MPI Manual requirements; painting subcontractors choosing the Maintenance Bond option must provide a maintenance bond consent from a reputable surety company licensed to do business in Canada as follows:

.1 Warrant that painting work has been performed in accordance with MPI Manual requirements.

.2 Provide a cash value to repair or replace defective coatings in the event that the original installer is not able to perform warranty work.

2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers that have attained the prerequisites for ecologically sustainable labelling mark on their products and may be incorporated into the Work include; but are not limited to, the following:

.1 Sherwin-Williams LLC

.2 Benjamin Moore and Co. Limited

.3 Akzo Nobel N.V.

.4 PPG Industries Inc.

2.2 MATERIALS

.1 Primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, and other painting materials shall be in accordance with the MPI Manual "Approved Product" listing and shall be from a single manufacturer for each system used.

.2 Materials such as linseed oil, shellac, and other accessory materials shall be the highest quality product of an approved manufacturer listed in the MPI Manual and shall be compatible with other coating materials.

.3 All materials and paints shall be lead and mercury free and shall have low VOC content where possible.

.4 Colour and Finish Schedule:

.1 For paint colour, gloss values and paint location, refer to Section 09 06 00 Finishes Schedule and drawings for requirements.

3 Execution

3.1 PREPARATION OF SURFACES:

.1 Prepare surfaces in accordance with MPI Manual requirements. Refer to the Manual for specific surface preparation requirements for each substrate material.

3.2 APPLICATION

.1 Paint when substrates and environmental conditions (heating, ventilation, lighting and completion of other work) are acceptable for applications of products specified in this Section.

.2 Paint surfaces requiring paint or stain finish to Premium MPI Manual finish requirements with application methods in accordance with best trade practices for type and application of materials used.

.3 Continue paint finishes through behind wall mounted items.

.4 Painting coats specified are intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer's recommendations.

.5 Apply a minimum of four coats of paint where deep or bright colours are used to achieve satisfactory results.

.6 Parking, Traffic and Pedestrian Areas:

.1 Glass Reflective Beads for Pavement Marking: Suitable for application to a wet paint surface for light reflectance. Apply beads at a minimum rate of 0.5 kg/l (5 lbs/g) to an MPI listed white or yellow latex or alkyd zone/traffic marking paint

.1 Paint lines with 102 mm (4") wide white or yellow painted lines as indicated in drawings and the requirements or authorities having jurisdiction.

.2 Paint barrier free accessible parking bays and refuge areas with appropriate symbol designation in accordance with the requirements or authorities having jurisdiction.

3.3 AESS (ARCHITECTURALLY EXPOSED STRUCTURAL STEEL) EXTERIOR FINISH

.1 Proprietary High-build, low gloss, three-component, epoxy/urethane paint system.

.1 Preparation and Priming: Clean and degrease entire surface of shop primed steel using cleaner in accordance with manufacturer's written instructions.

.1 Acceptable Cleaning Products:

.1 Devprep 88 by AkzoNobel N.V.

.2 Duraprep PREP 88 by PPG Industries inc.

.3 Great Lakes Laboratory – Extra Muscle – pre paint cleaner / de greaser by Sherwin Williams.

.2 Pretreat and touch-up damaged surfaces in accordance with paint manufacturer's written instructions.

.3 Primer: Steel is shop coated with primer, coordinate with division 05 Section Structural Steel. Prime in accordance with manufactures recommendations for minimum film thickness:

.1 Acceptable Primer Products:

.1 Cathacoat 302H by Akzonobel N.V.

.2 Dimetcote 302H by PPG Industries.

.3 FASTCLAD ZINC HS Reinforced Zinc Primer (B69A352 / B69V352) by Sherwin Williams.

.2 Sealing of Gaps: Prior to the application of finish coating, thoroughly abrade gaps by hand sanding, where specified surface preparation is not possible, avoiding damage to adjacent surfaces. Seal gaps with gap sealer applied per manufacturer's written instructions; apply neatly so that irregularities are not visible after finish coat is applied.

.1 Acceptable Gap Sealer Products:

.1 Devmat 142HB by AkzoNobel N.V.

.2 Megaseal CF/Amercoat 114A by PPG Industries.

.3 STEEL-SEAM FT 910 Epoxy Patching & Surfacing Compound (B58W910 / B58V910) by Sherwin Williams.

.3 Base and Intermediate Coat: Field apply two coats of epoxy coating, each coat not less than 5.0 mils dry film thickness, brush, spray or roller application.

.1 Acceptable Base and Intermediate Coat Products:

.1 Devran 224V, low VOC by AkzoNobel N.V.

.2 Amerlock 2 VOC by PPG Industries.

.3 MACROPOXY HIGH SOLIDS EPOXY (B58W400 / B58V400) by Sherwin Williams.

.4 Top Coat: Field apply one full coats of urethane gloss enamel coating specified for AESS, each coat not less than 2.0 mils dry film thickness, brush, spray or roller application.

.1 Acceptable Top Coat Products:

.1 Devran 379H, low VOC AkzoNobel N.V.

.2 Amercoat 450H by PPG Industries.

.3 HIGH SOLIDS POLYURETHANE GLOSS (B65 300 / B65 V30) by Sherwin Williams.

3.4 EXTERIOR SURFACES

.1 Paint exterior surfaces in accordance with the MPI Manual painting systems listed in this section.

.2 Asphalt Surfaces (Zone / Traffic Marking for Drive and Parking Areas):

.1 EXT 2.1A: Latex Zone / Traffic Marking.

.3 Structural Steel and Metal Fabrications:

.1 EXT 5.1R Water based light industrial semi gloss coating (over epoxy primer and high build epoxy).

.4 Galvanized Metal (doors, frames, railings, misc. steel, pipes, overhead decking, ducts, gutters, flashing, etcetera):

.1 EXT 5.3L Polyurethane, pigmented finish (over epoxy primer) - for use on high contact / high traffic areas

3.5 INTERIOR SURFACES

.1 Paint interior surfaces in accordance with the MPI Manual painting systems listed in this section.

.2 Concrete Vertical Surfaces (including walls):

.1 INT 3.1M: Institutional Low Odor / VOC eggshell finish (over water base primer sealer, low VOC)

.3 Concrete Horizontal Surfaces (floors and stairs):

.1 INT 3.2G: Waterborne concrete floor sealer with anti slip aggregates.

.2 INT 3.2H: Latex zone/traffic marking finish (for traffic and parking lines, etc.)

.4 Cementitious Composition Board Surfaces:

.1 INT 3.3G Institutional Low Odor/ VOC semi gloss finish (over waterbase primer sealer).

.5 Concrete Masonry Units (smooth and split face block and brick):

.1 INT 4.2K: Water based light industrial coating eggshell finish (over latex block filler).

.6 Miscellaneous Metal Fabrications:

.1 INT 5.1N: Water Base Light Industrial Coating semi gloss finish (over epoxy primer).

.7 High Performance Interior Paint System for Structural Steel Members:

.1 Structural Steel Members (Shop Primed).

.1 Shop Priming: Surface preparation to SSPC SP6. One coat of organic zinc-rich epoxy primer Zinc Clad III HS B69A100 Series by Sherwin-Williams at 125 um (5 mils) DFT.

.2 Site clean surface to SSPC SP2 or SP3. Touch up with shop primer.

.3 One coat of semi-gloss acrylic polyurethane Acrolon 218 HS B65-650 Series by Sherwin-Williams at 152 um (6 mils) DFT.

.2 Metal Deck.

.1 Surface preparation to SSPC SP1.

.2 One coat of water based wash primer DTM Wash Primer B71Y1 by Sherwin-Williams at (25 um (1 mil) DFT.

.3 One coat of semi-gloss acrylic polyurethane Acrolon 218 HS B65-650 Series by Sherwin-Williams at 152 um (6 mils) DFT.

.8 Galvanized Metal (doors, frames, railings, misc. steel, pipes, overhead decking, ducts, etcetera):

.1 INT 5.3NL Institutional Low Odor / VOC semi gloss finish (over water base galvanized primer).

.9 Plaster and Gypsum Board (gypsum board, drywall, and other sheet gypsum materials):

.1 INT 9.2M: Institutional Low Odor / VOC (over primer sealer, low odor low VOC)

.1 Walls: Eggshell finish.

.2 Ceilings: Flat finish.

3.6 MECHANICAL AND ELECTRICAL EQUIPMENT

.1 Paint “unfinished” conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and texture to match adjacent surfaces, in the following areas:

.1 In exposed to view exterior and interior areas.

.2 In interior high humidity interior areas.

.3 In boiler room, mechanical and electrical rooms.

.2 Leave conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks in unfinished areas.

.3 Paint inside of ductwork where visible behind louvers, grilles and diffusers beyond sight line with primer and one coat of matt black (nonreflecting) paint.

.4 Paint the inside of light valances gloss white.

.5 Refer to Mechanical and Electrical specifications for painting, banding, stencilling of other surfaces/equipment, and generally as follows:

.1 Paint gas piping gas standard yellow where visible in service spaces.

.2 Paint both sides and all edges of plywood backboards for equipment before installation.

.3 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

.4 Do not paint over nameplates.

3.7 SITE QUALITY CONTROL

.1 Painted surfaces will be considered to lack uniformity and soundness if any of the following defects are apparent at time of field review when viewed from a distance of 4’ from the painted surface:

.1 Runs, sags, hiding or shadowing by inefficient application methods

.2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles

.2 Painted surfaces will be considered as deficient if any of the following defects are apparent at time of field review, regardless of viewing distance.

.1 Damage due to touching before paint is sufficiently dry or any other contributory cause.

.2 Damage due to application on moist surfaces or caused by inadequate protection from the weather.

.3 Damage or contamination of paint due to windblown contaminants (dust, sand blast materials, salt spray, etcetera)

.3 Painted surfaces found as unacceptable shall be replaced or repaired at no cost to the City or the Contract Administrator:

.1 Small affected areas may be touched up

.2 Large affected areas or areas without sufficient dry film thickness of paint shall be repainted.

.3 Runs, sags or damaged paint shall be removed by scraper or by sanding before application of new paint coats.

3.8 PROTECTION

.1 Protect newly painted exterior surfaces from rain and snow, condensation, contamination, dust, salt spray and freezing temperatures until paint coatings are completely dry.

.2 Curing periods shall exceed the manufacturers recommended minimum time requirements.

.3 Erect barriers or screens and post signs to warn of or limit or direct traffic away or around work area as required.

3.9 CLEANUP

.1 Remove all paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

.2 Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.

.3 Remove combustible rubbish materials and empty paint cans each day and safely dispose of it in accordance with requirements of authorities having jurisdiction.

.4 Clean equipment and dispose of wash water or solvents, and other cleaning and protective materials (rags, drop cloths, masking papers, etcetera), paints, thinners, paint removers and strippers in accordance with the safety requirements of authorities having jurisdiction.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Supply all labour, materials, equipment, services and perform all operations required to complete all epoxy wall and ceiling coatings installation.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 QUALITY ASSURANCE

.1 Qualifications: Execute work of this Section by applicators approved by epoxy coating manufacturer having proven record of satisfactory installations similar to that specified and with proper equipment and skilled workers to perform it expeditiously. If requested, submit proof of these qualifications.

.2 Regulatory Requirements: Fire Hazard Classification as determined by ULC testing in accordance with ULC S102 shall not exceed following: Flame Spread 25.

.3 Maintenance Seminars: Engage a factory authorized service representative to train the City's maintenance personnel on proper procedures and schedules for maintaining the work.

.4 Sample Installation: At Site, in area designated by the Contract Administrator provide sample installation for each type and colour of coating, including primer, block filler and necessary number of coats to obtain specified finish, showing colour, bond and quality of work. Modify sample installations to obtain approval. Do not proceed with work until sample installations have been approved. Approved sample installations shall become standard of comparison for work of this Section and may form part of the Work.

.5 Pre-Installation Meeting: Prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review procedures to be adopted, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.6 Manufacturer's Site Inspection: Have the manufacturer's technical representative inspect the work at suitable intervals during application and at conclusion of the work of this Section, to ensure the work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.7 Testing of Substrate: Test substrate after preparation for Product installation is complete and filler, patching or levelling compound is fully cured. Conduct testing on substrate free of sealer, oil, grease and other agents detrimental to the test and the installation of the Products. Locate test sites to cover representative installation areas. Do not proceed with work when the test results do not conform to the specified allowable.

.1 Concrete Wall Cohesive Strength: Minimum 1.5 MPa (210 psi) by tensile load as tested to CSA A23.2-6B. Do one test for every 1000 sq.ft. or fraction thereof.

.2 Moisture Vapour Transmission: ASTM D4263 plastic sheet method, no visible condensation or vapour allowed. Do one test for every 500 sq.ft. or fraction thereof.

.3 Surface Moisture Content: Maximum 4%, tested by moisture meter. Do one test for every 500 sq.ft. or fraction thereof.

.4 Surface Temperature: Minimum 3 deg C above the measured dew point.

1.5 SUBMITTALS

.1 Samples for Verification: Provide 305 mm x 305 mm (12" x 12") samples of each type of epoxy coating on representative substrate showing stages of application. Submit additional samples until approval is obtained. Make corrections to mix as required to secure correct colour and texture. Label sample(s) with Project name and number, applicator, names of material and manufacturer, area where material will be applied, date of sample, colour, texture and mix proportion.

.2 Maintenance Data: Provide specific instructions for maintenance, preservation, cleaning and adequate warning of maintenance practices or materials detrimental to finish surfaces.

.3 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentation in accordance to the following:

.1 Indoor Environmental Quality:

.1 EQ Credit 4.2 - Low-Emitting Materials: Paint and Coatings

1.6 DELIVERY, STORAGE, HANDLING & PROTECTION

.1 Deliver materials to Site in original unopened containers with manufacturer's labels and seals intact. Labels shall identify manufacturer's name, brand name of products, grade and type, application directions and shelf life or expiry date of product.

.2 Handle and store materials in accordance with manufacturer's printed directions. Store in warm, dry, lockable area until surfaces are ready for application.

.3 Prior to mixing, store components at temperature between 10 deg C and 32 deg C (50 deg F and 90 deg F) for minimum 24 hours before use.

.4 Store flammable materials in safe, approved containers to eliminate fire hazards. Remove from Site at end of each work shift.

.5 Do not use materials that has been stored for period of time exceeding maximum recommended shelf life of materials.

1.7 SITE CONDITIONS

.1 Do not apply coatings over substrate materials that contain over 3% moisture. Obtain approval of coating manufacturer of moisture content of substrate before proceeding with application.

.2 Maintain minimum surface temperatures at 10 deg C (50 deg F) for 24 hours before, during, and for 48 hours following application, or until cured.

.3 Maintain well-lit, dust-free and well-ventilated area.

.4 Comply with coating manufacturer's directions for maintenance of substrate temperatures, ventilation and other conditions required to execute and protect work.

.5 Allow new concrete substrate to cure for minimum of 28 days.

1.8 PROTECTION

.1 Protect adjacent surfaces not scheduled to receive coatings from damage and overspray resulting from work of this Section. If necessary, cover or mask surfaces adjacent surfaces to those receiving coating including fixtures and equipment.

.2 Replace at no extra cost, materials soiled by coatings during application and storage, and from which spillage cannot be completely removed.

.3 Erect barriers to prevent entry and presence of workers not performing work of this Section during application of coating and for 48 hours following completion of application.

1.9 WARRANTY

.1 Warrant work of this Section against defects and deficiencies for period of five (5) years commencing on Substantial Performance. Promptly correct defects to satisfaction of and at no expense to the City. Defects shall include, but not be limited to, crazing, blistering, fading, bond failure and softening. Damage due to structural failure of base, surface, water seepage or abnormal abuse is exempted from warranty.

2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design products are named in this Section; additional manufacturers offering similar epoxy coating systems may be incorporated into the work provided they meet the performance requirements established by the named products.

.2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Sika Canada

.2 Neogard

2.2 MATERIALS – EPOXY WALL COATING

.1 Epoxy Coating for Cast-in-Place Concrete or Concrete Block Substrate:

.1 High solids, 2 components, thermosetting cold cure epoxy high build coating, high impact and abrasion resistance; 2 coats application for minimum DFT of 0.38 mm (15 mils). Finish in high gloss, standard colour.

.1 Acceptable Products:

.1 Sikagard 62 by Sika Canada.

.2 Epoxal 3:1 by Niagara Protective Coatings Ltd.

.3 Stoneglaze VSF by Stonhard Ltd.

.2 Concrete Block Filler and Concrete Patching Compound: As recommended by wall coating manufacturer and suitable for anticipated conditions.

.2 Reinforced Epoxy Coating for Gypsum Board Substrate:

.1 High solids, 2 components, thermosetting cold cure epoxy high build coating, high impact and abrasion resistance; glass fiber mesh reinforced, 4 coats application for minimum DFT of 0.64 mm (25 mils). Finish in high gloss, standard colour.

.1 Acceptable Products:

.1 Sikagard 62 by Sika Canada.

.2 Epoxal 3:1 by Niagara Protective Coatings Ltd.

.3 Stoneglaze VSD by Stonhard Ltd.

2.3 ACCESSORIES

.1 Sealant: ASTM C920, multi-component type, as recommended by coating manufacturer, standard colour.

.2 Backer Rod: Polyethylene, urethane, neoprene or vinyl closed cell, foam rope with Shore "A" hardness of 20 and tensile strength between 140 and 200 kPa.

.3 Primer: As recommended by wall coating manufacturer.

3 Execution

3.1 EXAMINATION

.1 Ensure surfaces to be coated are sound, clean, non-dusting, cured, free from oil and efflorescence and any other contaminants.

.2 Report immediately defects and unsatisfactory conditions. Commencement of work shall imply acceptance of existing conditions.

.3 Ensure surface temperature and moisture content of substrate meet minimum environmental requirements outlined herein.

3.2 PREPARATION

.1 Prepare existing or new surfaces and apply primer to substrate as per manufacturer's recommendations.

.2 Mix coatings in accordance with manufacturer's directions.

3.3 APPLICATION

.1 Apply work of this Section before adjacent work is painted.

.2 Do not apply coating over non-hardening sealants or caulking materials

.3 Block Filler and Patching Compound: Apply at a thickness to ensure complete coverage with pores and cracks filled.

.4 Apply coatings in accordance with manufacturer's instructions to produce monolithic wearing surface of minimum DFT indicated to even, uniform in colour and appearance, free from marks, runs, craters or other defects detrimental to appearance or performance. Match approved samples.

.5 Broadcast aggregate into wet floor coatings to refusal. Remove excess aggregate prior to applying finish coats, as recommended by the manufacturer.

.6 Allow proper cure time between coats as recommended by manufacturer. Protect surface from damage during this time.

.7 Provide water-tight seal to all pipes and projections coming through wall coating, using sealant.

.8 Do not apply wall coatings over sealed control and expansion joints. Advise other Sections in advance of sealant application until wall coating system is cured.

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section includes requirements for visual display boards, tack boards, hardware, trim and accessories.

1.2 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM E84, Test for Surface Burning Characteristics of Building Materials

.3 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC S102, Standard Method of Test for Surface Burning Characteristics

.4 Porcelain Enamel Institute (PEI):

.1 PEI 501, Appearance Properties of Porcelain Enamel.

.2 PEI 502, Mechanical and Physical Properties of Porcelain Enamel

1.3 SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting work of this section:

.1 Shop Drawings: Submit shop drawings for each type of visual display board required including, but not limited to, the following:

.1 Include dimensioned elevations.

.2 Show location of joints between individual panels where unit dimensions exceed maximum panel length.

.3 Include sections of typical trim members.

.4 Show anchors, grounds, reinforcement, accessories, layout, and installation details.

.2 Product Data: Submit product data for each type of visual display board indicated.

.3 Samples for Verification: Provide samples for verification for the following products, showing colour and texture or finish selected; include sample sets showing the full range of variations expected where finishes involve normal colour and texture variations; prepare Samples from the same material to be used for the Work:

.1 Visual Display Boards: Sample panels not less than 200 mm x 300 mm, mounted on the substrate indicated for the final Work. Include a panel for each type, colour and texture required.

.2 Aluminum Trim and Accessories: Samples of each finish type and colour, on 150 mm long sections of extrusions and not less than 100 mm squares of sheet or plate. Include Sample sets showing the full range of colour variations expected.

.2 Sustainable Design Submittals: Coordinate project sustainable design requirements with Standard Documents Package; in addition, provide information for following specific requirements of this Section:

.1 MR Credit 4.1 and 4.2 – Recycled Content:

.1 Content: Use materials with recycled content of such that the sum of post-consumer and ½ pre-consumer recycle content constitutes at least 10 % of the total value of materials in the Project, of which materials specified in this Section have a contributory effect.

.2 Compliance Requirements: Submit manufacturer's information indicating recycled content of materials installed for the Project, consisting of product cut sheets, product literature or other documentation such as letters from the manufacturer that clearly indicate the percentage of weight of post-consumer and pre-consumer recycled content.

1.4 PROJECT CLOSEOUT SUBMISSIONS

.1 Provide operations and maintenance information for Operation and Maintenance Data Manual.

.2 Submit data for cleaning of finishes and maintenance, and of operational hardware.

1.5 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by the Contract Administrator:

.1 Source Limitations: Obtain pre-manufactured visual display boards through one source from a single manufacturer.

.2 Engage an experienced installer who is an authorized representative of visual display board manufacturer for both installation and maintenance of the type of products required for this Project.

.3 Maintenance Seminars: Provide, to the City, training seminars and recommendations on Product maintenance procedures.

1.6 SITE CONDITIONS

.1 Verify field measurements before preparation of shop drawings and before fabrication to ensure proper fitting and as follows:

.1 Coordinate fabrication schedule with construction progress to avoid delaying the Work:

.2 Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

.2 Establish dimensions and proceed with fabricating visual display surfaces without field measurements where field measurements cannot be made without delaying the work, coordinate wall construction to ensure actual dimensions correspond to established dimensions.

1.7 WARRANTY

.1 Provide manufacturers written guarantee, signed and issued in the name of the City, to replace the following items for defective material and workmanship for the time stated from date of Substantial Performance:

.1 Framing, Panels and hardware: Failure of performance requirements specified in Contract Documents; 1 year.

2 Products

2.1 MANUFACTURERS

.1 Specified Products: Work of this Section is based on products manufactured by ASI Visual Display Products. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance

.1 Architectural School Products Ltd

.2 Claridge Products and Equipment Inc.

.3 C.P. Distributors Ltd.

.4 Crestway Systems Ltd.

.5 Egan Visual Inc.

.6 Malem Architectural Specialties Ltd.

.7 Shanahan's Ltd.

2.2 MARKER BOARDS

.1 Writing Face Panel: White colour porcelain enamel meeting Porcelain Enamel Institute Standards PEI S104 and to the manufacturers standard, completely fused on one piece 24 gauge electroplated steel under pressure and low temperature.

.1 Surface must remain flat after fabrication.

.2 Have surface washable with general household detergent and cleanable with cleaning fluid, acetone, alcohol, lacquer thinner or 10% caustic soda solution.

.2 Core: 11 mm (7/16") impregnated absorbing fibreboard laminated under heat and pressure to face panel and back sheet utilizing adhesives that ensure rupturing of the component materials before failure of joint contract surfaces.

.3 Back-Up Balancing Sheet: 0.4 mm (28 gauge) zinc coated stretcher levelled steel in one unjointed section.

.4 Aluminium Trims and Frames:

.1 6063 T5 aluminium alloy with satin finish clear etched and anodized 0.05 mm (.002") satin finish free from extruding draw marks and surface scratches.

.2 Perimeter Trim: 19 mm (3/4") exposed face and weight of approximately 0.372 kg/m (0.25 lbs./lineal foot).

.3 Chalk Tray: Triangular box section for chalkboard complete with contour fitting end castings, 100 mm (4") projection from wall.

.5 Tack Strips:

.1 Factory pre-laminated tack surface, consisting of 6 mm (1/4") thick natural fine grained cork laminated to 6 mm (1/4") particle board or hardboard substrate under pressure with waterproof adhesive that will not delaminate or rupture at the contact surfaces.

.1 Aluminium Trims: Perimeter trims.

3 Execution

3.1 EXAMINATION

.1 Inspect Work and conditions affecting the Work of this Section. Proceed only after deficiencies, if any, have been corrected.

.2 Ensure that all anchors and setting or installing components provided by this Section for installation are properly located and installed.

3.2 INSTALLATION

.1 Erect Work in strict accordance with manufacturer's written instructions.

.2 Conceal all anchors and fitments. Exposed heads of fasteners not permitted. All joints in exposed work to be flush hairline butt joints.

.3 Mount display boards as indicated on drawings.

.4 Refer to schedule and details on drawings for sizes locations, confirmed on site with the City before installation.

.5 Install work rigid, straight, square, plumb and horizontal lines level.

.6 Mount on site tack strips, and accessories as indicated.

.7 Join boards by the use of steel spline and an extruded polyvinyl slotted insert to ensure a flush butt joint with a hairline appearance. Mount boards separately. Install aluminium dust stop where boards occur on top of counters or shelves.

3.3 CLEANING

.1 At completion and continuously as Work proceeds, remove all surplus materials, debris and scrap.

.2 At completion of Work, remove all protective surface covering film and wrappings. Clean all frames and hard surfaces using mild soap or other cleaning agent approved by manufacturer.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.2 All work shall conform to the local Municipal Specifications where conflicts exist. Applicable CSA standards will prevail where ANSI or ASTM conflict with CSA standards.

1.2 SECTION INCLUDES

.1 Traffic control signs complying with local provincial transportation standards and as specified. See Construction Drawings for type, location, and quantity of signs required.

1.3 RELATED WORK SPECIFIED ELSEWHERE

.1 City of Winnipeg Standard Construction Specifications

.2 Manitoba Transportation and Infrastructure Traffic Management and Road Safety

.3 Construction Drawings

.4 Manufacturer's mounting instructions

1.4 SUBMITTALS

.1 Submit submittals in accordance with the General Conditions and Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings:

.1 Submit fully dimensional shop drawings to Contract Administrator showing construction, assembly, elevations, sections and interfacing with work of other Sections.

.2 No work of this Section shall be fabricated until shop drawings and all other related submittals, documentation, certifications and samples as required by this Section, have been reviewed by Contract Administrator.

.3 Details shall indicate metal thicknesses, fasteners and welds, all anchorage assemblies and components and erection details.

.3 Submit necessary templates and instructions where supports, anchors or services have to be built-in by others.

1.5 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store materials in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

.4 Unsatisfactory materials shall be removed from the Site.

.5 Adequately protect the structure and work of other Sections during delivery, storage, handling and execution of the work of this Section.

.6 Provide tools, plant and other equipment required for the proper execution of the work of this Section.

2 Products

2.1 ACCEPTABLE MANUFACTURER

.1 As approved by local Municipality.

2.2 SIGNS

.1 "ACCESSIBLE PARKING SYMBOL" Signs.

2.3 POSTS

.1 Round, galvanized posts with galvanized sign-mounting hardware for each sign, or as otherwise specified.

3 Execution

3.1 INSTALLATION

.1 Install posts in 18" (450mm) round x 4'-0" (1.2m) deep concrete foundations. Set posts vertical and plumb with bottom of sign at 6'-6" (2.0m) above finished grade.

.2 Mount signs in accordance with manufacturer's written instructions.

3.2 CLEANING AND ADJUSTING

.1 Upon completion of the work of this Section, or when directed by Contract Administratort remove all protective coatings and coverings. Clean and polish all exposed surfaces.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Furnish all labour and materials necessary for the completion of work in this Section as shown on the Contract Drawings and specified herein.

.2 Work in this Section includes but is not limited to:

.1 Solid Phenolic Urinal Screens

.2 Hardware

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings showing and describing in detail materials, finishes, dimensions, details of connections and fastenings elevations, plans, sections, thicknesses, hardware and any other pertinent information.

.2 Samples:

.1 Submit necessary templates and instructions where supports or anchors have to be built-in by others.

.2 Submit one sample of each of the following:

.1 Hinge, latch, panel fitting.

.2 Corner section, 300mm x 300mm (12" x 12") showing colour, corner, edge and core construction.

1.4 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location.

.2 Do not permit delivery of work to job site until building is sufficiently dry, wet trades are completed and the moisture readings of surfaces in proposed storage area is less than 18%.

.3 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Store materials flat on level surface. Protect materials with suitable non-staining waterproof coverings, but allow for air circulation at sides.

1.5 WARRANTY

.1 Warrant that the solid phenolic partitions and screens shall be free from defects in materials or workmanship in accordance with General Conditions for a period of ten (10) years and agree to promptly make good defects by replacing defective solid phenolic partitions and screens in finish to match original finish and in a manner satisfactory to the City. Defects shall include, but not be limited to, bubbling, delamination of faces, or edges, warp, twist, bow exceeding 1/4" and telegraphing of core. "Replace" as used herein includes installing panels, pilasters, hardware, shoes including hanging and fitting doors.

2 Products

2.1 MANUFACTURERS

.1 Specified Products: Work of this Section is based on products manufactured Black Core Phenolic by ASI Global Parittions. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

.1 Urinal Screens:

.1 1114mm (42") long x 610mm (24") wide wall hung type solid phenolic urinal screens with institutional hardware.

2.2 MATERIALS

.1 Solid Phenolic, Melamine Surfaced, Panels, Pilasters and Doors:

.1 Plastic Laminate Face Sheets: High pressure, paper based, melamine surfaced, laminated plastic sheets, conforming to CAN3-A172-M, with thickness tolerances in accordance with Table 1 of CAN3-A172-M and plastic laminate grades as follows:

.1 Cores: Solid phenolic type core material. Thicknesses as specified herein.

.2 Bituminous Paint: Acid and alkali resistant bituminous isolation coating.

.3 Butyl Tape: Extruded, High grade macro-polyisobutylene tape of width and shore hardness to suit conditions.

.4 Building Paper: No.15 asphalt saturated, organic felt in accordance with CSA A123.3.

.5 Hardware and Fittings (Institutional):

.1 'U' Channels: 1.2 mm thick (18 gauge) continuous 'U' shaped stainless steel channel extending full height of panels and screens.

.2 Hardware Material and Finish: Stainless steel shall be AISI 18-8 type 304 alloy conforming to ASTM A167.

.3 Hardware Fasteners: Vandal resistant, torks stainless steel machine screws installed from inside compartments. Door hardware shall also have factory installed threaded metal inserts in doors and pilasters.

.4 Install matching 19 mm (3/4") thick x 100 mm (4") wide overhead bracing between pilasters for reinforcing. Fasten with stainless steel plates and screws on the inside of each stall.

2.3 FINISHES

.1 Panel Colours:

.1 Refer to Section 09 06 00 Finishes Schedules for colours and types requirements.

.2 Stainless Steel:

.1 AISI No.4 brushed finish.

2.4 FABRICATION AND MANUFACTURE

.1 Shop fabricate toilet partitions. Take site measurements for areas where partitions are to be located and fabricate to suit site dimensions.

.2 Fabricate panels from solid phenolic core material with high pressure matte plastic laminate surfaces fused to core. Edges shall be "black". Stiles and doors shall have a finished thickness of 19 mm (3/4") thick. Panels shall be 13mm (1/2") thick.

.3 Check sizes and locations for washroom accessories and if necessary, reinforce panels.

.4 Prepare panels to accept tissue dispensers and grab bars where indicated on drawings.

.5 Design supports to withstand, within acceptable deflection limitations, their own weight, the weight of the toilet partitions, loads imposed by the motion of partition doors and all live loads, which might be applied to the toilet partitions in the course of their normal function.

3 Execution

3.1 INSPECTION

.1 Check areas scheduled to receive partitions and urinal screens for correct dimensions, plumbness of walls and soundness of surfaces that would affect installation of holding brackets.

.2 Verify spacing of plumbing fixtures to assure compatibility with installation of partitions.

.3 Do not begin installation of partitions until conditions are satisfactory and agreement on details with the City or contractors were well understood.

3.2 INSTALLATION

.1 Install urinal screens in strict accordance with manufacturer's installation recommendations.

.2 Install urinal screens plumb, level and securely fastened in the locations shown on the drawings.

.3 Perform drilling of steel, masonry and concrete necessary to install the work of this Section.

.4 Co-ordinate installation with the work of trades providing wall and floor finishes, washroom accessories and other adjacent partitions and constructions.

.5 Isolate contact surfaces to prevent electrolysis due to metal contact with masonry, concrete or dissimilar metal surfaces. Use bituminous paint, building paper, butyl tape or other approved means.

.6 Install hardware supplied under this Section and ensure that it is visually aligned.

.7 Securely install panels to walls with fittings to make a strong and rigid installation.

.8 Locate wall channels so that holes for mounting occur in ceramic tile joints.

.9 Install urinal screens to locations on walls as indicated on drawings, plumb, level and rigidly secured in place.

.10 Install partitions allowing the following clearances and tolerances:

.1 Between panel edges and wall: 25 mm +3 mm (1" +1/8").

3.3 ADJUSTMENT

.1 Upon completion of the work or when directed, remove all traces of protective coating or paper, and polish compartments.

3.4 CLEANING

.1 Clean and make good surfaces soiled or otherwise damaged in connection with the work of this Section. Replacing finishes or materials that cannot be satisfactorily cleaned.

.2 Upon completion of the work, remove all debris, equipment and excess material resulting from the work of this Section from the site.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Furnish labour, materials and other services to complete the fabrication and installation of washroom accessories include attachment hardware.

.2 Include all materials and fitments required for the operation of any unit furnished, in the manner, direction and performance shown on the shop drawings and specified herein.

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A153/A153M, Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware

.2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.3 ASTM A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

.4 ASTM A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable

.2 2015 City of Winnipeg Accessibility Design Standard Third Edition

1.4 SUBMITTALS

.1 Provide submittals specified and as required to assess conformance with the Contract Documents, in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data: For each product, indicate manufacturers and product name, including installation requirements and instructions.

.3 Shop Drawings: Show and describe in detail, materials, finishes, dimensions, details of connections and fastenings, elevations, plans, sections, metal gauges, hardware and any other pertinent information.

.1 Provide Professional Engineer stamped shop drawing for wall reinforcement of adult change table and grab bars

.4 Coordinate the work of this Section with the placement of internal wall reinforcement.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store materials in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

.4 Unsatisfactory materials shall be removed from the site.

.5 Adequately protect the structure and work of other Sections during delivery, storage, handling and execution of the work of the Section.

.6 Provide tools, plant and other equipment required for the proper execution of the work of this Section.

1.6 ELECTRICAL CO-ORDINATION

.1 Electrical Requirements: Coordinate wiring requirements and power characteristics of work with building electrical system. Do wiring in strict conformity with requirements of the Electrical Code and Electrical Sections.

.1 Work by Electrical Sections: Supply and installation of disconnect switch/junction box and power to the disconnect switch/junction box.

.2 Work by This Section: Wiring and connection at and from disconnect switch/junction box to motors, starters, switches, controls, safety devices and other items requiring power.

.2 Employ licensed electrician to wire and interconnect all operational and safety components for the Work. Terminate wiring required for connection to control circuitry and power at NEMA enclosures. Ground all control wiring.

.3 Electrical Components, Devices, and Accessories: CSA certified and labelled.

2 Products

2.1 MANUFACTURERS

.1 Specified Products: Work of this Section is based on the products listed in the schedule. Products by manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

.2 Acceptable Product Suppliers:

.1 ASI Watrous - Global Partitions

.2 Bobrick

.3 Frost

.4 Koala Kare

.5 Dyson

2.2 MATERIALS

.1 Provide one of the products indicated for each designation in the Washroom and Custodial Accessory Schedule below, subject to compliance with specified requirements.

.2 Stainless Steel: In accordance with ASTM A666, Type 304, with No. 4 finish (satin); minimum nominal thickness as established by product type.

.3 Sheet Steel: Steel: In accordance with ASTM A1008/A1008M, cold rolled, commercial quality; minimum nominal thickness as established by product type; surface preparation and metal pretreatment as required for applied finish.

.4 Galvanized Steel Sheet: In accordance with ASTM A653/A653M, minimum Z180 coating designation.

.5 Galvanized Steel Mounting Devices: In accordance with ASTM A153/A153M, hot dip galvanized after fabrication.

.6 Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

.7 Emergency Call System: Refer to Section 08 70 00 for requirement.

.8 Supply for installation under other Sections, mounting devices and reinforcement required to be built-in for support of grab bars, adult change table and imposed loads. Be responsible for giving proper notice to other Sections and supplying such reinforcement when required by other Sections for building in.

2.3 FABRICATION

.1 Washroom and Custodial Accessories:

.1 Surface Mounted:

.1 Fabricate units with tight seams and joints, and exposed edges rolled.

.2 Hang doors and access panels with continuous stainless steel hinge.

.3 Provide concealed anchorage where possible.

.2 Recessed Mounted:

.1 Fabricate units of all welded construction, without mitred corners.

.2 Hang doors and access panels with full length, stainless steel hinge.

.3 Provide anchorage that is fully concealed when unit is closed.

.2 Workmanship shall be best grade of modern shop practice known to recognized manufacturers specializing in this work. Joints and intersecting members shall be accurately fitted, made in true planes with adequate fastening. Wherever possible fastenings shall be concealed.

.3 Isolate where necessary to prevent electrolysis between dissimilar metal to metal or metal to masonry or concrete contact.

.4 Fabricate and erect work square, plumb, straight, true and accurately fitted. Provide adequate reinforcing and anchorage.

.5 Drilling shall be reamed and exposed edges left clean and smooth.

.6 Include anchors and fastenings necessary to anchor work of this Section.

.7 Coordinate with other sections for reinforcement and attachment of washroom accessories.

.8 Keys: Provide universal keys for internal access to accessories for servicing and re-supplying. Provide minimum of six (6) keys to the City's representative.

.9 Wall Reinforcement for Adult Change Table:

.1 HSS steel and steel plates within wall assembly to accommodate future installation of adult change table. Provide Professional Engineer stamped shop drawing for wall reinforcement to support the product as specified in the schedule.

3 Execution

3.1 EXAMINATION

.1 Inspect surfaces over which the work of this Section is dependent for any irregularities detrimental to the application and performance of the work. Notify Contract Administrator in writing of all conditions which are at variance with those in the Contract Documents and/or detrimental to the proper and timely installation of the work of this Section. The decision regarding corrective measures shall be obtained from the Contract Administrator prior to proceeding with the affected work.

.2 Commencement of work of this Section implies acceptance of surfaces and conditions.

3.2 INSTALLATION

.1 Make thorough examination of drawings and details, determine the intent, extent, materials, conditions of interfacing with other work and be fully cognizant of requirements.

.2 Work of this Section shall include complete installation of items specified herein. Installation shall be in strict accordance with manufacturer's printed instructions.

.3 Securely fasten accessories, level and plumb in the locations shown on the drawings and specified herein. All fastenings shall be concealed.

.4 Co-ordinate the work of this Section with the work of other Sections to provide the necessary recesses, edge conditions wood blocking for the accessories as required.

.5 Do all drilling of steel, masonry and concrete necessary for the anchorage of the work.

.6 Installed grab bars shall be capable of supporting a downward pull of 2.22 kN (500 lbf) and to local authorities having jurisdiction requirement.

.7 Install adult change table capable to carry minimum load of 1.33 kN (300 lbf) and to local authorities having jurisdiction requirement.

3.3 ADJUSTING

.1 Check mechanisms, hinges, locks and latches, adjust and lubricate to ensure that accessories are in perfect working order.

3.4 CLEANING

.1 Upon completion of the work of this Section or when directed by Contract Administrator, remove all protective coatings, and coverings. Clean and polish exposed surfaces.

3.5 WASHROOM AND CUSTODIAL ACCESSORY SCHEDULE

Code	Description	Model
CH1	Coat Hooks for Toilet Stalls: Satin finished stainless steel, square profiled robe hook with concealed mounting, provide 2 for each washroom, located as directed by Contract Administrator.	7340-S by ASI B-76717 by Bobrick
CH2	Coat Hooks for Change Rooms: Satin finished stainless steel, rectangular hook strip, 2mm thick, four stainless steel hooks snap down for safety, complete with tamper-resistant mounting screws. Unit 455mm wide x 140mm high x 20mm deep. Provide in change rooms, in locations indicated on the Drawings.	129 by ASI B-985 by Bobrick
FNDU	Feminine Napkin Dispenser Unit: Surface mounted, equipped for two (2) coin operation, napkin and tampon dispenser, stainless steel construction, handicap accessible.	0864 by ASI B-2800 x 2 by Bobrick 608-3 by Frost
FND	Feminine Napkin Disposal: Surface mounted, concealed fastening, self closing disposal opening with leak proof plastic receptacle and 10 disposable liners for initial stocking purposes for each unit.	0852 by ASI B-270 by Bobrick 622 by Frost

Code	Description	Model
GB1	Grab Bar – 610 mm long: 1.214mm (0.048") thickness; 610 mm (24") long x 38mm (1-1/2") diameter, straight, stainless steel, slip resistant grip, concealed mounting, cap secured with vandal resistant set screws.	3801-24 by ASI B-6806.99 x 24 by Bobrick
GB2	Grab Bar – 765 mm long: 1.214mm (0.048") thickness; 765mm (30") long x 38mm (1-1/4") diameter, straight, stainless steel, slip resistant grip, concealed mounting, cap secured with vandal resistant set screws.	3801-30 by ASI B-6806.99 x 30 by Bobrick
GB3	Grab Bar: "L"-shape grab bar, 760mm (30") long x 760mm (30") high 38mm (1-1/2") diameter, stainless steel, slip resistant grip, concealed mounting, cap secured with vandal resistant set screws.	Type 04 by ASI B-6898.99 by Bobrick
GB4	Swing Up Grab Bar: Swing up operation, 740mm (29") long x 32mm (1-1/4") diameter, stainless steel, concealed mounting, cap secured with vandal resistant set screws.	3414 by ASI B-4998 by Bobrick
GB5	Grab Bar – 300 mm long: Vertical mount, 1.214mm (0.048") thickness; 305mm (12") long x 38mm (1-1/4") diameter, straight, stainless steel, slip resistant grip, concealed mounting, cap secured with vandal resistant set screws.	3801-12 by ASI B-6806.99 x 12 by Bobrick
GB6	Grab Bar – 900 mm long: 1.214mm (0.048") thickness; 915mm (36") long x 38mm (1-1/4") diameter, straight, stainless steel, slip resistant grip, concealed mounting, cap secured with vandal resistant set screws.	3801-36 by ASI B-6806.99 x 36 by Bobrick
RPTD	Paper Towel Dispenser and Disposal: Surface mounted, handicap accessible, capable of holding 600 C-fold or 800 multi-fold or 1100 single-fold paper towels, with leak proof waste container.	64676-9 by ASI B-380349 by Bobrick 400C by Frost
MR1	Mirror (Tilt): Framed, 910mm (36") high x 460mm (18") wide, fixed tilt installation for barrier free access, mounted 1000mm (40") to bottom of frame.	0535-1836 by ASI B-293 x 1836 by Bobrick
MR2	Mirror (Flat): Framed, 910mm (36") high x 460mm (18") wide, fixed installation, mounted 1000mm (40") to bottom of frame.	0600-1836 by ASI B-290 x 1836 by Bobrick
TPD	Toilet Tissue Dispenser: Double roll, surface mounted, tissue dispenser with concealed mounting, stainless steel construction, bright polished finish with theft resistant spindles.	7305-2B-R009 by ASI B-686-60 by Bobrick

Code	Description	Model
TSC	Seat-Cover Dispenser: Surface-mounted toilet seat cover disperser, concealed fastening, type 304, 20 gauge stainless steel, one-piece seamless construction. Capacity: 250 single fold paper covers.	0477-SM by ASI B-4221 by Bobrick
SD2	Wall-Mounted Soap Dispenser: Heavy-duty all-purpose valve, wall-mounted stainless steel soap dispenser, 1.2L capacity with visible viewing window:	0347 by ASI B-2111 by Bobrick
JS	Janitor's Shelf with Mop and Broom Holders and Hooks: 864mm (34") long x 330mm (13") high x 200mm (8") deep. Shelf constructed of minimum 18-8 stainless steel, type 304, 18 gauge. Utility hooks fabricated of 11 gauge stainless steel, and mop holders fabricated of cadmium plated steel. Pivoting, spring-loaded serrated rubber cam shall hold round handles of 22mm to 32mm (7/8" to 1-1/4") diameter	1308-3 by ASI B-239 x 34 by Bobrick
HD	Hand Dryer: High-speed hand dryer, surface mounted, touch free infra-red activation. Motor: 208 V, 60 Hz.	20200-2 Tri-Umph by ASI Airblade Hand Dryer by Dyson
SHC	Shower Curtain: Opaque, matte white vinyl, 0.2mm (.008") thick, containing antibacterial and flame retardant agents. Complete with grommets every 150mm (6"), and hemmed top, bottom and sides.	1200-V by ASI B-204-2 by Bobrick

Code	Description	Model
SHCH	Shower Curtain Hook: Fabricated of type 304 stainless steel alloy 18-8, solid formed wire 2.5mm (0.98") in diameter. Hook shall accommodate 25mm to 32mm (1" to 1-1/4") diameter curtain rods.	1200-SHU by ASI B-204-1 by Bobrick
SHCR	Shower Curtain Rod: Extra-heavy duty rod, 32mm (1-1/4") diameter fabricated of alloy 18-8 stainless steel, type 304, 18 gauge. Flanges fabricated from 20 gauge stainless steel. Satin Finish. Length: As determined on the Drawings.	1204 by ASI B-6047 by Bobrick
SHSD	Shower Soap Dish: Type 304 stainless steel, matte polished finish. Mounting clamp for stud walls. Unit 7 3⁄16" W, 5" H (185 x 125mm). Rough Wall Opening: 6" W, 4" H, 4" min. depth (150 x 100 x 100mm).	7404 by ASI B-4380 by Bobrick
SHS	Shower Seat: Constructed of durable, water-resistant, ivory colored, 5⁄16" (8mm) thick solid phenolic. Frame and mounting bracket are Type 304 stainless steel and self-locking mechanism. Supports up to 500 lbs (227 kg) when properly installed. Seat 22" (560mm) wide, projects 15 13⁄16" (400mm) from wall.	8203 by ASI B-5192 by Bobrick
ADCT	Adult Change Table: Wall mounted, electrically powered height adjustable from 300 mm to 1000 mm (12” to 39”) height adjustment, weight capacity of 200 kg (441 lb), upwards speed 15 mm/s (0.03 mph), downwards speed 20 mm/s, wired hand control.	SCT 1000, R8593118000 by Pressalit
BR	Toilet Backrest 32mm diameter, 1.6mm wall thickness stainless steel tube, with 250mm x 100mm x 13mm thick plastic laminated backrest.	1028 by Frost Products.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of commercial metal lockers and accessories required for a complete and functioning installation.

1.3 REFERENCES

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

.2 American Society for Testing and Materials (ASTM) A1008 - Standard Specification for Steel Sheet, Carbon, Cold-Rolled, Commercial Quality.

.3 ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

.4 ADAAG - American with Disabilities Act, Accessibility Guidelines.

.5 ANSI A117.1 - Accessible and Usable Buildings and Facilities

1.4 SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting work of this section:

.1 Product Data: Submit product data from manufacturer indicating proposed components and installation requirements.

.2 Shop Drawings: Show and describe in detail materials, finishes, dimensions, details of connections and fastenings elevations, plans, sections, metal thicknesses, hardware and any other pertinent information.

.3 Samples:

.1 Submit duplicate 12" X 12" samples of panel showing finish on both sides, two finished edges and core construction.

.2 Submit duplicate representative samples of each hardware item, including brackets, fastenings and trim.

.4 Submit necessary templates and instructions where supports or anchors have to be built-in by others.

.2 Provide maintenance data for maintenance of metal finishes work for incorporation into Maintenance Manual.

.3 Sustainable Design Submittals:

.1 LEED Submittals: Submit documentation in accordance to the following:

.1 Materials & Resources:

.1 MR Credit 4 - Recycled Content: 20% (post-consumer)

1.5 ADMINISTRATION REQUIREMENTS

.1 Coordination: Coordinate site dimensions affecting work of other Sections and provide data, dimensions and components, anchors and assemblies installed by other Sections in sufficient time for installation of products specified in this Section.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver, handle and store prefabricated units in accordance with manufacturer's directions.

.2 Store units at site on raised wood pallets protected from the elements and corrosive materials, and Do not remove from crates or other protective covering until ready for installation.

2 Products

2.1 MANUFACTURERS

.1 Specified Products: Work of this Section is based on the materials from the specified manufacturer. Products by manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator’s acceptance.

2.2 MATERIALS

.1 Sheet Steel: Cold rolled carbon steel, commercial quality stretcher levelled or temper rolled to stretcher levelled standard of flatness free from surface imperfections and conforming to ASTM A366/A336M-91.

.2 Locker Paint: Electrostatically applied, thermo-setting, high performance primer and powder coating.

.3 Welding Materials: Conforming to CSA W59.

.4 Fasteners: Non-corrosive type.

.5 Steel Tube: Conforming to ASTM A53-906.

.6 Steel Plate: Conforming to CAN/CSA-G40.20/G40.21, Grade 44W.

2.3 COMMERCIAL LOCKERS:

.1 Basis-of-Design Products: Traditional Collection by ASI Storage Solutions Inc.

.2 Size: Nominal 381 mm (15”) wide x 457 mm (18”) deep x 1830 mm (72”) high.

.3 Construction:

.1 Doors: One piece double wall envelope construction, minimum 20 gauge thick, welded construction, complete with recessed handle box.

.2 Frame: Minimum 16 gauge steel channel, welded construction complete with 11 gauge padlock hasp.

.3 Body: Minimum gauge requirements:

.1 Bottoms: 16 gauge

.2 Sides, Backs, and Shelves: 24 gauge.

.3 Bolt Spacing: 9” o.c. maximum spacing.

.4 Handle: Recessed lock pocket, one piece construction, 20 gauge.

.5 Tops: Flat, continuous overtop of a bank of lockers, 18 gauge.

.6 Hinge: Continuous, full length 1.3 mm (16 gauge) thick piano hinge riveted to both door and frame.

.4 Configuration:

.1 Metal Locker Type (ML-1): Single tier.

.2 Metal Locker Type (ML-2): Double tier.

.5 Finishes:

.1 Specially treat metal locker surfaces by phosphate conversion process conforming to CGSB 31-GP-105a, ready to receive locker paint finish.

.2 Remove grease and extraneous matter and then coat with iron phosphate and finish with two coats of baked enamel in a colour selected by the Contract Administrator. Body inside and outside, doors and frames with one uniform colour.

.3 Electrostatically apply locker paint to all metal locker surfaces. Colours refer to Section 09 06 00 Finishes Schedules for requirement.

2.4 BENCHES

.1 Basis-of-Design Products: Bench Top and Pedestals by ASI Storage Solutions Inc.

.2 Stationary Bench:

.1 Pedestal: 356 mm (14”) wide x 413 mm (16.25”) high, 1.3 mm (16 gauge) thick brushed stainless steel formed into the shape of a trapezoid.

.2 Bench Top: 19 mm (3/4”) thick phenolic composite, minimum 915 mm (36”) long x 305 mm (12”) deep bench top

.3 Finishes: Refer to Section 09 06 00 Finishes Schedules for colour requirement

2.5 FABRICATION – METAL LOCKERS

.1 General: Make work square, plumb, straight and true. Make joints and intersections tightly fitted and securely fastened.

.2 Finish: All parts to be thoroughly degreased, cleaned and given a bonding, rust-retarding phosphate coat and two finish coats of powder coating. Material then to be baked to produce a hard durable finish.

.3 Body: End sides to have double bend at front edge to add stiffness. Front edge of shelf to be bent to prevent small items from rolling off.

.4 Filler Panels: Extend filler panels from finished floor to top of sloping top. Top of panel to be same slope as sloping top. Secure panels from inside of lockers.

.5 Door Frames: Vertical members to have three right angle bends to reduce the danger of exposed edges and add strength. Horizontal members to have hem edge finish. Weld parts together to form a strong, rigid unit. Provide two rubber bumpers on lock side of frame each near the top and bottom of door.

.6 Doors: Fully enclosed at rear with a flush reinforcing sheet to form a closed box and make a rigid, whip-free unit. Face of door to be free from protruding handles, locks, louvers, etc.

.7 Bases (where concrete bases are not indicated): Minimum 1 mm thick sheet, finish to match locker colour, minimum 100 mm (4”) high, complete with top and bottom legs and intermediate vertical steel reinforcement at back.

.8 Commercial Locker Ventilation: Cut slots at top and bottom of each locker to allow air to flow freely in and out of entire locker from bottom to top.

.9 Locking and Latching: Make provision for locking with a standard combination padlock arrangement with no moving parts. Entire lock pocket recess shall be nickel plated with durable black nylon-coated pull and nylon type No. 6 friction catch permanently fixed in door with hidden fastener and aligned to accept plunger and hold door in closed position. Padlock: Supplied by the City.

.10 Number Plates: Black with bright contrasting block numerals on polished aluminum plate, riveted to door face, recessed into door. Numerals shall not less than 19 mm (3/4") high and non-erasable. Lockers shall be numbered as indicated later by the Contract Administrator.

.11 Interior Equipment: One hat shelf, three wall mounted die cast zinc plated hook attached to the wall of the locker.

.12 Hardware: Vandal resistant cadmium plated nuts, bolts, lock washers, nut covers, angle clips and fastenings.

3 Execution

3.1 EXAMINATION

.1 Do not begin installation until substrates and bases have been properly prepared.

.2 Notify Contract Administrator if substrate and bases are of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

.1 Install metal lockers and accessories at locations shown in accordance with manufacturer's instructions.

.2 Install lockers level and plumb with flush surfaces and rigid attachment to anchoring surfaces.

.3 Anchor lockers to floor and wall at 2000 mm or less, as recommended by the manufacturer.

.4 Bolt adjoining locker units together to provide rigid installation.

.5 Install sloping tops and metal fillers using concealed fasteners. Provide flush hairline joints against adjacent surfaces.

.6 Install front bases between legs without overlap or exposed fasteners. Provide end bases on exposed ends.

.7 Install benches by fastening bench tops to pedestals and securely anchoring to the floor using appropriate anchors for the floor material. Install free standing benches to locations indicated on drawings.

3.3 ADJUSTING AND CLEANING

.1 Adjust doors and latches to operate without binding. Verify that latches are operating satisfactorily.

.2 Touch-up with factory-supplied paint and repair or replace damaged products before Substantial Completion.

3.4 PROTECTION

.1 Protect installed products until completion of project.

END OF SECTION

1 General

1.1 SUMMARY

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.3 QUALITY ASSURANCE

.1 Subcontractor executing work of this Section shall have a minimum five (5) years continuous Canadian experience in successful manufacture and installation of work of type and quality shown and specified. Submit proof of experience upon Contract Administrator's request.

1.4 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings showing and describing in detail, materials, finishes, dimensions, details of connections and fastenings, elevations, plans, sections, metal gauges, hardware and any other pertinent information.

.2 Samples:

.1 Submit minimum 3" x 5" samples showing metal storage shelving finish and colour.

1.5 SUSTAINABLE DESIGN SUBMITTALS

.1 LEED Submittals: submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Documentation identifying quantity by weight of recycled content in products.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20 % of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project

.3 LEED Submittals: submit LEED submittal forms for Credit EQ 4.4 in accordance with the following:

.1 Composite Wood products including core materials, must contain no added urea-formaldehyde resins.

.2 Adhesives used to fabricate laminated assemblies must contain no urea-formaldehyde

1.6 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store materials in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

.4 Unsatisfactory materials shall be removed from the Site.

.5 Adequately protect the structure and work of other Sections during delivery, storage, handling and execution of the work of this Section.

.6 Provide tools, plant and other equipment required for the proper execution of the work of this Section.

2 Products

2.1 MATERIALS

.1 Metal storage shelving shall conform to the following requirements:

.1 Heavy-duty shelves:

.1 14 mm (9/16”) in height and be formed of 1.2 mm (18 gauge) cold rolled steel with flanges on all four sides.

.2 Front and rear flanges: turned “down” and “in”.

.3 Shelves to be adjustable on 38 mm (1-1/2”) centers vertically.

.4 Shelves to be supported front and rear by two shelves supports of 1.9 mm (14 gauge) hot rolled steel.

.5 Full depth (or through) shelves shall have mounting holes for attachment of optional center stop.

.6 Height of shelf (with heavy-duty shelf support): 31 mm (1-1/4”).

.2 Uprights:

.1 Consisting of 1.2 mm (18 gauge) cold rolled steel formed into either a 50 mm (2”) wide “Tee” shape common post, or a 25 mm (1”) wide “Angle” shape end post.

.2 Keyhole shaped slots are placed on 38 mm (1-1/2”) centers vertically on the inner face of the posts.

.3 “Closed” uprights shall have a 0.5 mm (24 gauge) closure panel between the posts.

.4 “Open” type uprights shall have a minimum of three 75 mm (3”) wide x 1.2 mm (18 gauge) spacers between the posts.

.3 Shoes: Form shoes from two steel plates of minimum 1.8 mm (13 gauge) x 190 mm (7-1/2") high die punched and formed plates with reinforcing ribs spot welded together. Equip all shoes with double 4 prong position system and lock in place for "positive" assembly with two machine bolts of 9.5 mm (3/8") diameter.

.4 Levellers: Equip each post and shoe with adjustable type floor levellers, capable of adapting to floor irregularities.

.5 Post Covers: Top all vertical posts with minimum 0.8 mm (20 gauge) steel post covers. Finish to match shelves.

.6 Shelf Deck: 19 mm (3/4”) thick plywood shelf deck sheathing, exterior grade Douglas Fir plywood, veneer core, Select Sheathing - Tight Face, unsanded, "B" faces.

2.2 FABRICATION

.1 Fit and assemble work in shop.

.2 Joints and intersecting members shall be accurately fitted, made in true planes with adequate fastening. Wherever possible fastenings shall be concealed.

.3 Isolate where necessary to prevent electrolysis between metal to metal or metal to masonry or concrete contact. Apply 2 coats of bituminous paint or butyl tape.

.4 Fabricate work of this Section square, plumb, straight, true and accurately fitted. Provide adequate reinforcing and anchorage.

.5 Drilling shall be reamed and exposed edges left clean and smooth.

.6 Include anchors and fastenings necessary to anchor work of this Section.

.7 Shelves Configuration:

.1 Fabricate shelves with minimum capacity of 227 kg (500 lbs), 100mm (4") above the finished floor, three tiers of shelves with adjustable height.

.2 Fabricate shelves with steel frame construction, complete with plywood deck shelving.

2.3 FINISHES

.1 Electrostatically Applied Baked Enamel:

.1 Finish all exposed surfaces of metal storage shelving with two (2) coats of electrostatically applied, alkali resistant, baked thermosetting acrylic enamel. Finish shall be free of drips, runs, orange peel, pitting, pot marks and other defects.

.2 Colours: As selected from the manufacturers standard product line.

.3 Pre-treat steel and apply primer and finish coats in strict accordance with manufacturer's written instructions. Thermally set finish coat(s) in strict accordance with the manufacturer's written instructions.

.4 Protect finish with strippable protective film.

2.4 SUSTAINABLE DESIGN PRODUCT DISCLOSURE AND OPTIMIZATION

.1 Sustainable design requirement submittals shall support the prerequisites and credits identified in the LEED v4 Scorecard, as described in Requirements and Documentation within the reference guide.

3 Execution

3.1 CONDITION OF SURFACES

.1 Inspect surfaces over which the work of this Section is dependent for any irregularities detrimental to the application and performance of the work of this Section. Notify Contract Administrator in writing of all conditions which are at variance with those in the contract documents and/or detrimental to the proper and timely installation of the work of this Section. The decision regarding corrective measures shall be obtained from the Contract Administrator prior to proceeding with the affected work.

.2 Commencement of work of this Section implies acceptance of surfaces and conditions.

3.2 INSTALLATION - GENERAL

.1 Make thorough examination of drawings and details, determine the intent, extent, materials, conditions of interfacing with other work and be fully cognizant of requirements.

.2 Work under this Sections shall include complete installation of items specified herein. Installation shall be in strict accordance with manufacturer's printed instructions.

.3 Do all drilling of the Work necessary for the anchorage of the work of this Section.

.4 Securely install metal storage shelving, plumb, level and true in the locations indicated on the drawings. All fastenings shall be concealed.

.5 Co-ordinate the work of this Section with the work of other Sections to provide the necessary recesses, edge conditions for the accessories as required.

3.3 CLEANING

.1 Upon completion of the work of this Section or when directed, remove all protective coatings and coverings. Clean and polish exposed surfaces.

3.4 SITE TESTING AND INSPECTIONS

.1 Indoor Air Quality Control Requirements: Perform work in accordance with the project's Indoor Air Quality Control plan for LEED credit Construction Indoor Air Quality Management Plan.

.2 Perform work in accordance with Fundamental Commissioning and Verification, and Enhanced Commissioning as per the LEED v4 Reference Guide.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Supply and install high density, tiered multi-level, boltless/rivet metal storage shelving system, structurally supporting a catwalk system between system elements and around perimeter with additional metal storage shelving, for increased floor area.

.2 Shelving system will include grating floors and stairs for upper levels, light fixtures for lower levels and any accommodations for wiring and sprinkler systems.

.1 Light fixture and sprinkler system Supply & Installation by others.

.3 Supply and installation of vertical-lift carousel type, parts storage towers.

.4 Engineered storage shelving systems to highest standards for local seismic installation considerations and regulations.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 QUALITY ASSURANCE

.1 Subcontractor executing work of this Section shall have a minimum five (5) years continuous Canadian experience in successful manufacture and installation of work of type and quality shown and specified. Submit proof of experience upon request.

1.5 SUBMITTALS

.1 Submit submittals in accordance with the Contract Requirements and Contract General Requirements.

.2 Shop Drawings:

.1 Submit shop drawings showing and describing in detail, materials, finishes, dimensions, details of connections and fastenings, elevations, plans, sections, metal gauges, hardware and any other pertinent information.

.3 Samples:

.1 Submit minimum 75mm x 125mm (3” x 5”) samples showing metal storage shelving finish and colour.

1.6 SUSTAINABLE DESIGN SUBMITTALS

.1 LEED Submittals: submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Documentation identifying quantity by weight of recycled content in products.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20 % of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project

.3 LEED Submittals: submit LEED submittal forms for Credit EQ 4.4 in accordance with the following:

.1 Composite Wood products including core materials, must contain no added urea-formaldehyde resins.

.2 Adhesives used to fabricate laminated assemblies must contain no urea-formaldehyde

1.7 DESIGN REQUIREMENTS

.1 Retain a Professional Engineer, registered in the province of the Work, to design details and connections of metal storage shelving, and ascertain that the following will comply with the requirements of the Building Code and the Contract Documents:

.1 Selection and design of connections not detailed on the Contract Documents;

.2 Fabrication of components;

.3 Erection of the work of this section.

.2 Design details and connections in accordance with requirements of applicable codes and authorities having jurisdiction.

.3 Design mezzanine and stair sections, attachments and connections, to support a minimum live load of 4.8 kN/m^2 or a concentrated load of 2.0 kN at any point on indicated tread widths in accordance with Building Code. All hand rails and guard rails for stairs and mezzanine areas are to be included and meet or exceed building code requirements.

.4 Design each shelf to sustain a uniformly distributed load of a minimum 900 kg (2000 lbs.) per shelf, with a maximum allowable deflection of 5 mm (3/16”).

1.8 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store materials in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

.4 Unsatisfactory materials shall be removed from the Site.

.5 Adequately protect the structure and work of other Sections during delivery, storage, handling and execution of the work of this Section.

.6 Provide tools, plant and other equipment required for the proper execution of the work of this Section.

2 Products

2.1 MATERIALS

.1 Supply and install tiered high density, boltless/rivet metal storage shelving system and catwalks as indicated on the Drawings and specified herein.

.1 Basis of Design Manufacturer: SSI Schaefer, or approved equivalent.

.2 Multi-level Metal Tiered Storage Shelving:

.1 High Capacity Perimeter Post (Uprights): 38 mm x 38 mm x 1.6 mm (1-1/2” x 1-1/2” x 14 gauge) thick steel formed angle. Pre-punched holes at 38mm (1-1/2”) centers to accept different versions of breams.

.2 Angle Upright Post: 37 mm x 37 mm x 1.6 mm (1-15/32” x 1-15/32” x 14 gauge) thick steel formed angle. Pre-punched holes at 38 mm (1-1/2”) centers with flattened keyhole slots to accept rivets in beams.

.3 "T" Upright Post: 1.3 mm (16 gauge) thick steel formed into "T" form with 8 mm (5/16") cavity between two halves of post to allow two beams to be installed back to back.

.1 Dimensions: 85 mm x 49 mm (3-11/32" x 1-15/16"), with pre-punched holes at 38 mm
(1-1/2") centers with flattened keyhole slots to accept rivets in beams.

.4 Heavy Duty Channel Shelf Supports: 1.6 mm (14 gauge) thick steel formed into 83 mm (3-1/4") channel formations. Complete with two shoulder rivets on each end at 38 mm (1-1/2") centers to fit slots in upright posts and front/ back supports.

.5 Catwalk Decking: 38 mm (1-1/2") thick steel grating decking, as recommended by the manufacturer.

.6 Shelf Configuration:

.1 Part Storage Lower Shelf: 610 mm x 1220 mm x 2439 mm high (24" x 48" x 96").

.1 Four tiers shelving units, each includes equal assortment of drawers for 150 mm (6"), 305 mm (12"), and 457 mm (18") drawers.

.2 Part Storage Upper Shelf: 610 mm x 1220 mm x 2000 mm high (24" x 48" x 79").

.1 Four tiers shelving units.

.3 Parts Storage Tower Carousel:

.1 Provide equal array of trays for each tower:

.1 Light tray: 272 kg (600 lbs) capacity

.2 Medium tray: 363 kg (800 lbs) capacity

.3 Heavy tray: 454 kg (1000 lbs) capacity

.2 Number of Trays per Tower: 50 trays.

.3 Carousel Height: 5740 mm (18'-9").

.4 Vertical Travel Speed: 19812 mm (65') per minute.

.5 Shelf Configuration:

.1 Width: 2439 mm (8')

.2 Depth: 508 mm (20")

.6 Power Requirements: 600 VAC, 3 phase, 20 amps.

.7 Motor: 5 HP

.8 Accessories:

.1 Tray dividers, as provided by tower storage manufacturer.

.2 Laser Pointer for part location identification.

.3 Safety barrier as provided by tower storage manufacturer.

.4 Internal weight management system.

2.2 FINISHES

.1 Electrostatically Applied Baked Enamel:

.1 Finish all exposed surfaces of metal storage shelving with two (2) coats of electrostatically applied, alkali resistant, baked thermosetting acrylic enamel. Finish shall be free of drips, runs, orange peel, pitting, pot marks and other defects.

.1 Colours: As selected by the Contract Administrator from the manufacturer's standard product line.

.2 Pre-treat steel and apply primer and finish coats in strict accordance with manufacturer's written instructions. Thermally set finish coat(s) in strict accordance with the manufacturer's written instructions.

.3 Pans / Trays are galvanized steel, unpainted

2.3 SUSTAINABLE DESIGN PRODUCT DISCLOSURE AND OPTIMIZATION

.1 Sustainable design requirement submittals shall support the prerequisites and credits identified in the LEED v4 Scorecard, as described in Requirements and Documentation within the reference guide.

2.4 FABRICATION

.1 Fit and assemble work in shop.

.2 Workmanship shall be best grade of modern shop practice known to recognized manufacturers specializing in this work. Joints and intersecting members shall be accurately fitted, made in true planes with adequate fastening. Wherever possible fastenings shall be concealed.

.3 Isolate where necessary to prevent electrolysis between metal to metal or metal to masonry or concrete contact. Apply 2 coats of bituminous paint or butyl tape.

.4 Fabricate work of this Section square, plumb, straight, true and accurately fitted. Provide adequate reinforcing and anchorage.

.5 Drilling shall be reamed and exposed edges left clean and smooth.

.6 Include anchors and fastenings necessary to anchor work of this Section.

3 Execution

3.1 CONDITION OF SURFACES

.1 Inspect surfaces over which the work of this Section is dependent for any irregularities detrimental to the application and performance of the work of this Section. Notify Contract Administrator in writing of all conditions which are at variance with those in the contract documents and/or detrimental to the proper and timely installation of the work of this Section. The decision regarding corrective measures shall be obtained from the Contract Administrator prior to proceeding with the affected work.

.2 Commencement of work of this Section implies acceptance of surfaces and conditions.

3.2 INSTALLATION - GENERAL

.1 Make thorough examination of drawings and details, determine the intent, extent, materials, conditions of interfacing with other work and be fully cognizant of requirements.

.2 Work under this Section shall include complete installation of items specified herein. Installation shall be in strict accordance with manufacturer's printed instructions.

.3 Do all drilling of the Work necessary for the anchorage of the work of this Section.

.4 Securely install metal storage shelving, plumb, level and true in the locations indicated on the drawings. All fastenings shall be concealed.

.5 Co-ordinate the work of this Section with the work of other Sections to provide the necessary recesses, edge conditions for the accessories as required.

3.3 CLEANING

.1 Upon completion of the work of this Section or when directed, remove all protective coatings and coverings. Clean and polish exposed surfaces.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Supply and install structural pallet storage racks, welded structural tubing C-Channel complete with three rivets per connector and tapered keyhole connection slots.

.2 Supply and install structural pallet storage racks per above sized and configured for tire storage systems

.3 Engineered metal storage racks to highest standards for local seismic installations.

.4 Provide accommodation for Sprinkler systems to meet building code requirements.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 QUALITY ASSURANCE

.1 Subcontractor executing work of this Section shall have a minimum five (5) years continuous Canadian experience in successful manufacture and installation of work of type and quality shown and specified. Submit proof of experience upon Contract Administrator's request.

1.5 SUBMITTALS

.1 Submit submittals in accordance with the Contract Requirements and Contract General Requirements.

.2 Shop Drawings:

.1 Submit shop drawings showing and describing in detail, materials, finishes, dimensions, details of connections and fastenings, elevations, plans, sections, metal gauges, hardware and any other pertinent information.

1.6 SUSTAINABLE DESIGN SUBMITTALS

.1 LEED Submittals: submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Documentation identifying quantity by weight of recycled content in products.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20 % of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project

.3 LEED Submittals: submit LEED submittal forms for Credit EQ 4.4 in accordance with the following:

.1 Composite Wood products including core materials, must contain no added urea-formaldehyde resins.

.2 Adhesives used to fabricate laminated assemblies must contain no urea-formaldehyde

1.7 DESIGN REQUIREMENTS

.1 Retain a Professional Engineer, registered in the province of the Work, to design details and connections of storage racks, and ascertain that the following will comply with the requirements of the Building Code and the Contract Documents:

.1 Selection and design of connections not detailed on the Contract Documents;

.2 Fabrication of components;

.3 Erection of the work of this section.

.2 Design details and connections in accordance with requirements of applicable codes and authorities having jurisdiction.

.3 Design each pallet level to sustain a uniformly distributed load of a minimum 2300 kg (5000 lbs.) per level, with a maximum allowable deflection of 9/16".

.4 Design each folding tire rack to carry eight (8) tires with rims sized for urban transit buses. Each tire rack is to fit within a single level of a pallet storage rack and be easily moved in and out. Folding tire rack is to be designed to rest on the storage rack or on the floor in a manner easily moved by fork lift truck and to safely and securely transport eight (8) tires complete with rims.…

1.8 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store materials in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

.4 Unsatisfactory materials shall be removed from the Site.

.5 Adequately protect the structure and work of other Sections during delivery, storage, handling and execution of the work of this Section.

.6 Provide tools, plant and other equipment required for the proper execution of the work of this Section.

2 Products

2.1 MATERIALS

.1 Supply and install a selective, heavy duty, 4 bolts per beam connection, storage rack system, as indicated on the Drawings and specified herein.

.2 Design to accommodate in-rack fire suppression sprinklers installed by others.

.3 Pallet storage rack system with 4-tiers, confirm to the following requirements:

.1 Capacity: Minimum 2300kg (5000 lbs).

.2 Clear Dimension: 1070 mm deep x 2590 mm wide x 6500 mm high, 3 box beams.

.1 Outer Frames: 1067 mm (42") x 6910 mm (272").

.2 Inner Frames: 1067 mm (42") x 5640 mm (222").

.3 Complete rack system with one (1) ground level pallet, and three (3) above grade pallet bay with load beams. Minimum 1625 mm (64") clearance between beams.

.4 Post (Uprights): Heavy-duty construction with 75 mm (3") structural steel C-Channels, with pre-punched tear drop openings on 50 mm (2") centers, welded to base plate for securing to concrete substrate.

.5 Post: C3 structural frame, with pre-punched tear drop openings at 75 mm (3") centers, welded to base plate for securing to concrete substrate.

.6 Beam and Post Connectors: Structural steel beams, welded to post connectors, on 50 mm (2") centers, with pre-punched holes at 75 mm (3") centers for vertical posts.

.7 Provide the following materials to provide complete installation:

.1 Structural Crossbar / Beam

.2 Overlap Crossbar / Safety Bar

.3 Reinforced Post Cap

.4 Row Spacer

.4 Pallet storage rack system with 3-tier, conform to the following requirements:

.1 Capacity: Each tier to accommodate a folding tire rack with capacity for eight (8) urban transit bus tires complete with steel rims. Loaded tire rack capacity with minimum approximately 1090 kg (2400 lbs).

.2 Clear Dimension: 1070 mm (42") deep x 2590 mm (102") wide x 3000 mm (118") high, 3 box beams racks.

.1 First and Second Tier: Tire racks with load beams, have minimum clearance of 1473 mm (4'-10").

.2 Top Tiers: Storage rack, for other pallet materials such as rims and other related devices.

.3 Post (Uprights): Heavy-duty 75mm (3") structural steel C-Channels, pre-punched tear drop openings on 50mm (2") centers, welded to base plate for securing to concrete substrate.

.1 Post: C3 structural frame, with pre-punched tear drop openings at 75 mm (3") centers, welded to base plate for securing to concrete substrate.

.4 Beam and Post Connectors: Structural steel beams, welded to post connectors, on 50 mm (2") centers, with pre-punched holes at 75 mm (3") centers for vertical posts.

.5 Provide the following materials to provide complete installation:

.1 Structural Crossbar / Beam

.2 Overlap Crossbar/ Safety Bars

.3 Reinforced Post Cap

.4 Row Spacer

.5 For the portable tire rack storage, C-Channel insert for one level and safety bars for the top level.

.5 Folding Tire Racks shall conform to the following requirements:

.1 Tire Rack: 2375mm (93 1/2") long, 1016mm (40") deep, 1428mm (56-1/4") tall.

.2 Capacity: Eight (8) Urban Transit Bus tires per unit

.3 Moveable, stackable racks, which fit into pallet storage rack system.

.4 Acceptable manufacturer:

.1 Model MTFR folding tire rack by Martins Industries

.2 or approved alternate.

.6 Fixed Position Loose Tire and Wheel Rack for Working Area:

.1 Modular or custom fabricated rack to store loose tires in working area.

.2 Have rack capacity of 24 tires complete with rims.

.3 Provide rack to have 4 compartments divided by vertical pipe rails to accommodate 6 tires in each.

.4 Have frame or plate elements at the bottom to secure or hold tires in place and prevent falling.

.5 Provide base plates for rack securement to floor and wall.

2.2 FINISHES

.1 Electrostatically Applied Baked Enamel:

.1 Finish all exposed surfaces of storage racks with two (2) coats of electrostatically applied, alkali resistant, baked thermosetting acrylic enamel. Finish shall be free of drips, runs, orange peel, pitting, pot marks and other defects.

.1 Colours: As selected by the Contract Administrator from the manufacturer's standard product line.

.2 Pre-treat steel and apply primer and finish coats in strict accordance with manufacturer's written instructions. Thermally set finish coat(s) in strict accordance with the manufacturer's written instructions.

.3 Protect finish with strippable protective film.

2.3 SUSTAINABLE DESIGN PRODUCT DISCLOSURE AND OPTIMIZATION

.1 Sustainable design requirement submittals shall support the prerequisites and credits identified in the LEED v4 Scorecard, as described in Requirements and Documentation within the reference guide.

2.4 FABRICATION

.1 Fit and assemble work in shop.

.2 Workmanship shall be best grade of modern shop practice known to recognized manufacturers specializing in this work. Joints and intersecting members shall be accurately fitted, made in true planes with adequate fastening. Wherever possible fastenings shall be concealed.

.3 Isolate where necessary to prevent electrolysis between metal to metal or metal to masonry or concrete contact. Apply 2 coats of bituminous paint or butyl tape.

.4 Fabricate work of this Section square, plumb, straight, true and accurately fitted. Provide adequate reinforcing and anchorage.

.5 Drilling shall be reamed and exposed edges left clean and smooth.

.6 Include anchors and fastenings necessary to anchor work of this Section.

3 Execution

3.1 CONDITION OF SURFACES

.1 Inspect surfaces over which the work of this Section is dependent for any irregularities detrimental to the application and performance of the work of this Section. Notify Contract Administrator in writing of all conditions which are at variance with those in the contract documents and/or detrimental to the proper and timely installation of the work of this Section. The decision regarding corrective measures shall be obtained from the Contract Administrator prior to proceeding with the affected work.

.2 Commencement of work of this Section implies acceptance of surfaces and conditions.

3.2 INSTALLATION - GENERAL

.1 Make thorough examination of drawings and details, determine the intent, extent, materials, conditions of interfacing with other work and be fully cognizant of requirements.

.2 Work under this Section shall include complete installation of items specified herein. Installation shall be in strict accordance with manufacturer's printed instructions.

.3 Do all drilling of the Work necessary for the anchorage of the work of this Section.

.4 Securely install storage racks plumb, level and true in the locations indicated on the drawings. All fastenings shall be concealed.

.5 Co-ordinate the work of this Section with the work of other Sections to provide the necessary recesses, edge conditions for the accessories as required.

END OF SECTION

1 General

1.1 SCOPE

.1 This section includes all works to provide fully operational systems for:

.1 Bus coolant and lubricant storage and distribution.

.2 Waste coolant and lubricant collection and storage.

.3 Windshield Washer Fluid storage and distribution.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 29, Hangers and Supports.

.2 Section 20 05 93, Testing, Adjusting and Balancing (TAB) of Mechanical Systems.

.3 Section 22 15 13 Compressed Air Systems

.4 Section 23 10 05 DEF and Fuel Dispensing Systems.

1.3 REFERENCE STANDARDS

.1 ANSI American National Standards Institute

.2 ASME

.1 ANSI/ASME B1.20.1, Pipe Threads, General Purpose, Inch.

.2 ANSI/ASME B31.1, Power Piping.

.3 ASME B16.3, Malleable Iron Thread Fittings.

.4 ASME B16.5, Pipe Flanges and Flanged Fittings: NPS ½ through 24.

.5 ASME B16.11, Forged Fittings, Socket-Welding and Threaded.

.3 ASTM

.1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.2 ASTM A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.

.3 ASTM A106, Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service.

.4 ASTM A 511-96. Seamless Stainless Steel Mechanical Tubing

.4 CSA

.1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CSA C22.1 - Canadian Electrical Code, Part I (26th Edition), Safety Standard for Electrical Installations

.5 SAE

.1 SAE J515, Specification for Hydraulic O-Ring Materials, Properties and Sizes for Metric and Inch Stud Ends, Face Seal Fitting and Four Screw Flange Tube Connections.

.2 SAE J516, Hydraulic Hose Fittings.

.3 SAE J517, Hydraulic Hose.

.4 SAE J343, Test and Test Procedures for SAE 100R Series – Hydraulic Hose and Hose Assemblies.

.6 UL/ULC

.1 CAN/ULC-S601 - Standard for Shop Fabricated Steel Aboveground Tanks for Flammable and Combustible Liquids

.2 CAN/ULC-S602 - Aboveground Steel Tanks for Fuel Oil and Lubricating Oil

.3 ULC CAN/ULC-S612:2016 Standard for Hose and Hose Assemblies for Flammable and Combustible Liquids

.4 ULC CAN/ULC-S620:2016 Standard for Hose Nozzle Valves for Flammable and Combustible Liquids

.5 ULC CAN/ULC-S633:2017 Standard for Flexible Connector Piping for Fuels

.6 ULC CAN/ULC-S642:2016 Standard for Compounds and Tapes for Threaded Pipe Joints

.7 ULC CAN/ULC-S644:2016 Standard for Emergency Breakaway Fittings for Flammable and Combustible Liquids

.8 ULC CAN/ULC-S651:2016 Standard for Emergency Valves for Flammable and Combustible Liquids

.9 ULC CAN/ULC-S652:2016 Standard for Tank Assemblies for the Collection, Storage and Removal of Used Oil

.10 ULC CAN/ULC-S653:2016 Standard for Aboveground Horizontal Steel Contained Tank

.11 Assemblies for Flammable and Combustible Liquids

.12 ULC CAN/ULC-S655-15 Standard for Aboveground Protected Tank Assemblies for Flammable and Combustible Liquids

.13 ULC CAN/ULC-S661-10 Standard for Overfill Protection Devices for Flammable and Combustible Liquid Storage Tanks

.14 ULC CAN/ULC-S663-11 Standard for Spill Containment Devices for Flammable and Combustible Liquid Aboveground Storage Tanks

.15 ULC CAN/ULC-S664:2017 Standard for Containment Sumps, Sump Fittings, and Accessories for Flammable and Combustible Liquids

.16 ULC CAN/ULC-S675.1-14 Standard for Volumetric Leak Detection Devices for Underground and Aboveground Storage Tanks for Flammable and Combustible Liquids

.17 ULC CAN/ULC-S675.2-14 Standard for Nonvolumetric Precision Leak Detection Devices for Underground and Aboveground Storage Tanks and Piping for Flammable and Combustible Liquids

.18 ULC CAN/ULC-S676-15 Standard for Refurbishing of Storage Tanks for Flammable and Combustible Liquids

.19 ULC CAN/ULC-S677-14 Standard for Fire Tested Aboveground Tank Assemblies for Flammable and Combustible Liquids

.20 ULC CAN/ULC-S679:2017 Standard for Metallic and Nonmetallic Underground Piping for Flammable and Combustible Liquids

1.4 SUBMITTALS

.1 Submit the following product data and shop drawings in one package.

.1 Product data:

.1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 for all Products listed in this Section, indicating:

.1 Performance criteria, compliance with appropriate reference standards, characteristics, limitations, and troubleshooting protocol.

.2 Motor data and product data for all optional accessories.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00, indicated on drawings:

.1 Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.

.2 Complete wiring diagrams including schematics.

.3 Dimensions, construction details, materials, recommended installation and support, mounting bolt holes, sizes and locations, and point loads.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Commissioning:

.1 Submit Commissioning Plan, Commissioning Procedures, Certificate of Readiness, Deficiency Report and Commissioning Closeout Report.

1.5 CLOSEOUT SUBMITTALS

.1 Submit following for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 00:

.1 Identification: Manufacturing name, type, year, serial number, number of units, capacity, and identification of related systems.

.2 Functional description detailing operation and control of components.

.3 Performance criteria and maintenance data.

.4 Operating instructions and precautions.

.5 Safety precautions.

.6 Component parts availability including names and addresses of spare part suppliers.

.7 Consumables.

.8 Lubrication schedule indicating lubrication points and type of lubricant recommended.

.9 Maintenance and troubleshooting guidelines/protocol, and recommended equipment for analysis and repair.

.10 List of items submitted to Commission's Representative as required: Keys, tools, special devices, maintenance materials.

1.6 QUALITY ASSURANCE

.1 Manufacturer shall have a minimum of 10 years of continuous design and fabrication of this type of equipment and systems for the Canadian commercial/industrial market.

.2 Installation shall be performed by or under the direct supervision of qualified red seal tradesperson for the type of work provided. Installation shall be site reviewed by authorized manufacturer's representative.

.3 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning on-site installation, with Contractor's representative and Contract Administrator to verify project requirements.

.4 Manufacturer's representative to:

.1 Supervise:

.1 Installation of equipment.

.2 Start-up testing.

.3 Performance verification testing.

.4 Commissioning.

.2 Certify installation.

.3 Conduct training sessions.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect garage systems equipment from scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 Products

2.1 COMPRESSED AIR SYSTEMS

.1 Refer to Section 22 15 00.

2.2 AIR OPERATED PUMPS

.1 Pumps for Engine Oil, synthetic and non-synthetic

.1 Application: tank mounted

.2 Cast Aluminum Body

.3 Double acting air operated piston pump,

.4 Universal stub pump, flange mounted.

.5 Motor Size: 76mm (3") effective diameter

.6 Volume per cycle: approximately 130 cm3

.7 Ratio: 5:1

.8 Air pressure operating pressure: 275 to 1100 kPa (40 to 180 psig)

.9 Air consumption: 12.1 LPS @ 10.6 lpm (6 scfm @ 2.8 usgpm)

.10 Maximum free flow delivery: 47 LPM (12.1 usgpm)

.11 Air inlet size: 9mm (3/8”) nominal

.12 Fluid inlet size: 37mm (1 ½”) nominal

.13 Fluid outlet size: 12mm (1/2”) nominal

.14 Sound Pressure Level at 1m: <80 dBa

.15 Accessories;

.1 pressure regulator,

.2 shut off valve,

.3 union,

.4 check valve,

.5 coupler,

.6 tank mounting kit, bracket,

.7 Suction assembly

.8 Silencer for the air outlet side.

.16 Minimum 7 year limited warranty.

.17 Approved products:

.1 Graco Fireball 300 5:1

.2 Approved equivalent

.2 Pumps for Grease up to NLGL-2 viscosity:

.1 Application: 180kg Drum

.2 Cast Aluminum Body

.3 Double acting air operated piston pump,

.4 Universal stub pump, flange mounted.

.5 Motor Size: 108mm (4-1/4”) effective diameter

.6 Output per cycle: approximately 30 grams (1 oz.)

.7 Ratio: 50:1

.8 Air pressure operating pressure: 275 to 1035 kPa (40 to 150 psig)

.9 Air consumption: 90 LPS@ 2.4kg/min (43cfm @ 5.3 lb/min)

.10 Maximum free flow delivery: 4.1kg/min (9 lbs./min)

.11 Air inlet size: 12mm (1/2 in.) Nominal

.12 Fluid outlet size: 9mm (3/8 in.) Nominal

.13 Sound Pressure Level at 1m: <82 dBa

.14 Accessories;

.1 Pressure regulator

.2 Sshut off valve,

.3 Union,

.4 Check valve,

.5 Coupler,

.6 Lift kit and support.

.7 Suction assembly

.8 Silencer for the air outlet side.

.9 10 year limited warranty.

.15 Approved products:

.1 Graco Fireball 425 50:1

.2 Approved equivalent.

.3 Pumps for Engine Coolant (EC) and Waste Coolant (WC)

.1 Application: Tank Mount (EC), Wall Mount (WC)

.2 Double diaphragm

.3 Aluminum body,

.4 Wetted parts: TPE or Hytrel

.5 Stainless steel seats,

.6 Ratio: 1:1

.7 Air pressure operating pressure: 138 to 600 kPa (20 to 100 psig)

.8 Maximum suction lift: 5m (15 ft) or more

.9 Operating Temperature Range: -12°C to 65°C (0°F to 150°F)

.10 Maximum free flow delivery (water): 189 LPM (50 usgpm)

.11 Maximum solids passing: minimum 3mm (1/8 in.)

.12 Air inlet size: 12mm (1/2 in.)

.13 Fluid inlet size: 25mm (1 in)

.14 Fluid outlet size: 25mm (1 in)

.15 Sound Pressure Level at 1m: < 84 dBA (for 50cpm @ 480kPa (70 psig))

.16 Accessories;

.1 Pressure regulator

.2 Shut off valve,

.3 Pressure relief valve,

.4 Wall mount bracket,

.5 Pump silencer.

.17 10 year limited warranty.

.18 Approved products:

.1 Graco Husky 1050 1:1

.2 Approved equivalent.

2.3 ELECTRIC PUMPS

.1 Pumps for Windshield washing fluid (WWF):

- .1 Electric diaphragm pump.
- .2 Application: Wall Mount
- .3 Double diaphragm
- .4 Aluminum Center section / polypropylene body,
- .5 Wetted parts: Viton
- .6 Internal leak sensor
- .7 Ratio: 1:1
- .8 Maximum suction lift: 7m (22 ft) or more
- .9 Operating Temperature Range: -35°C to 40°C (-31°F to 104°F)
- .10 Maximum free flow delivery (water): 114 LPM (30 usgpm)
- .11 Maximum solids passing: minimum 3mm (1/8 in.)
- .12 Fluid inlet size: 25mm (1 in.) flanged
- .13 Fluid outlet size: 25mm (1 in.) flanged
- .14 Electrical:
  - .1 Motor:
    - .1 IP66 Washdown protection
    - .2 120v/1ph/60hz AC
    - .3 FLA: 12 amps.
  - .2 Pump mounted controller:
    - .1 Integral drive motor mounted controller
    - .2 Speed control potentiometer
    - .3 Analogue input, 4-20ma
    - .4 Digital input and output.
    - .5 LED Indication for:
    - .6 Power on
    - .7 Motor fault
    - .8 Leak sensor
    - .9 Normal operation
- .15 System Duplex Pump Controller
  - .1 CSA approved panel assembly
  - .2 Controller Function:
    - .1 Lead/lag pump control via discharge pipe pressure transducers (2)
    - .2 Pipe pressure below transducer 1 set point of 345 kPa (50 psig) (adjustable 0 to 415 kPa (60 psig)
    - .3 Pump 1 signalled on

.4 Pipe pressure not attained after 5 seconds (Adjustable 0 to 30 seconds)

.5 Pump 2 signalled on.

.6 Pipe pressure above transducer 2 set point of 485 kPa (70 psig) (Adjustable 415 to 690 kPa (50 to 100 psig)

.7 Controller turns off pump(s).

.8 Alternate lead pump at each startup.

.3 Hand/Off/Auto for each pump.

.4 LED indicators:

.1 Power on/off indication.

.2 Pump signalled on

.16 Acceptable products – pumps:

.1 Graco Quantum i30

.2 Approved equivalent.

.17 Acceptable products – system controller:

.1 Pump manufacturer controller

.2 CSA Certified panel shop controller

2.4 STORAGE TANKS – WASTE PRODUCTS

Above Ground Storage Tanks (AST): Waste Oil (WO), Waste Coolant (WC)

.1 General operation and installation:

.1 Tanks will be installed outdoors

.2 Equipped with:

.1 Overfill protection

.2 Continuous level monitoring

.3 Secondary containment monitoring

.3 Waste product will be pumped to tank from a waste collection station for each liquid.

.2 Rectangular or Cylindrical horizontal steel tank

.3 ULC-S652

.4 Double wall

.5 Saddles or base to suit tank shape.

.6 Lifting lugs

.7 Minimum Fittings and appurtenances: (all fittings NPS standard sizes)

.1 Main tank

.1 Emergency vent to suit tank size.

.2 Primary vent with weather cap, to suit tank size.

.3 50 mm fill, with pipe to 150mm from bottom

.4 50 mm suction, with pipe to 25 mm from bottom

.5 Spill box for manual tank fill

.6 50 mm gauge/monitor with mechanical tank level gauge

.7 50 mm spare

.8 25mm (1 in.) drain connection,

.9 Mechanical overfill protection.

.10 Mechanical tank level gauge

.2 Secondary containment:

.1 50mm (2 in.) inspection/draw off

.2 25mm for monitoring sensor

.3 Emergency vent

.8 ULC label

.9 Tank content label frame, and content placard

.10 Enamel coated exterior surface – manufacturer standard colour.

.11 Tanks with top at more than 1.5 m above finished floor shall include 2 step front platform for ease of access to containment monitoring.

.12 Tank capacities:

.1 Refer to the schedules.

.13 Acceptable product:

.1 Foremost

.2 Granby

.3 Tidy Tank

.4 Approved equivalent.

2.5 STORAGE TANKS – NEW LIQUIDS

.1 Above Ground Storage Tank (AST): Engine Oil (EO), Engine Coolant (EC)

.2 General operation and installation:

.1 Tanks will be installed in the Lube Room

.2 Remote filled by piping from outside cam-lock spill box location.

.3 Tank equipped with:

.4 Overfill protection

.5 Continuous level monitoring and high level alarm to outside fill location.

.6 Secondary containment monitoring

.7 Liquid will be pumped from tank to dispensing locations in the Repair Bays.

.3 Rectangular or Cylindrical horizontal steel tank

.4 ULC-S602

.5 Double wall

.6 Saddles or base to suit tank shape.

.7 Lifting lugs

.8 Minimum Fittings and appurtenances: (all fittings NPS standard sizes)

.1 Main tank

.1 Emergency tank vent to suit tank size.

.2 Primary tank vent with weather cap, so suit tank size.

.3 50 mm fill, with pipe to 150mm from bottom

.4 50 mm gauge/monitor with mechanical tank level gauge

.5 50 mm suction, with pipe to 50 from bottom of tank

.6 50 mm spare

.7 25mm (1 in.) drain connection,

.8 Mechanical overfill protection.

.9 Mechanical tank level gauge

.2 Secondary containment:

.1 50mm (2 in.) inspection/draw off

.2 25mm for monitoring sensor

.3 Emergency vent.

.9 ULC label

.10 Tank content label frame, and content placard

.11 Enamel coated exterior surface – manufacturer standard colour.

.12 Tank capacities:

.1 Refer to the schedules.

.13 Acceptable product:

.1 Foremost

.2 Granby

.3 Tidy Tank

.4 Approved equivalent.

2.6 STORAGE TANK – WINDSHIELD WASHER FLUID (WWF)

.1 Above Ground Storage Tank (AST): WWF

.2 General operation and installation:

.1 Tank will be installed outside

.2 Direct filled by delivery tanker via cam-lock spill box location.

.3 Tank equipped with:

.1 Overfill protection

.2 Continuous level monitoring.

.3 Secondary containment monitoring

.4 Liquid will be pumped from tank to dispensing locations in the Service Lanes.

.3 Rectangular or Cylindrical horizontal steel tank

.4 ULC-S602

.5 Double wall

.6 Saddles or base to suit tank shape.

.7 Lifting lugs

.8 Fittings and appurtenances: (all fittings NPS standard sizes)

.1 Main tank

.1 Emergency tank vent to suit tank size.

.2 Primary tank vent with weather cap, to suit tank size.

.3 50 mm fill, with pipe to 150mm from bottom

.4 50 mm gauge/monitor with mechanical tank level gauge

.5 50 mm suction piping

.6 50 mm spare

.7 25mm (1 in.) drain connection,

.8 Mechanical overfill protection.

.2 Secondary containment:

.1 50mm (2 in.) inspection/draw off

.2 25mm for monitoring sensor

.3 Emergency vent

.9 ULC label

.10 Tank content label frame, and content placard

.11 Enamel coated exterior surface – manufacturer standard colour.

.12 Tank capacities:

.1 Refer to the schedules.

.13 Acceptable product:

.1 Foremost

.2 Granby

.3 Tidy Tank

.4 Approved equivalent.

2.7 HOSE REELS

.1 Industrial grade

.2 Heavy-duty double pedestal arm hose reel

.3 Approved and rated for application and pressures

.4 Spring return

.5 4 way hose guide rollers

.6 Hose Capacity:

.1 Refer to hose reel schedules.

.7 Hose: refer to section 2.8 in this document

.8 Isolation Valve

.9 Flexible connector

.10 Refer to the schedules

.11 Approved product:

.1 Hannay

.2 Reelcraft

.3 Approved equivalent.

2.8 HOSE REEL FLEXIBLE CONNECTIONS AND HOSES

.1 Requirements common to all flexible hose, unless specified otherwise

.2 All flexible hoses supplied from single manufacturer.

.3 Banded clamp end and gear clamp connection fittings are not permitted for use.

.4 Length: to suit installation arrangements shown on drawings unless noted otherwise.

.5 Sufficient length to achieve minimum required bend radius and installation as recommended by the hose manufacturer

.6 Hose size and end fittings to suit equipment connections.

.7 Complete with rated swivel unions.

.8 SAE 100Rx hose, suitable for pressure and temperature application.

.1 Minimum Operating Pressure Rating: to suit pump dead head pressure.

.2 Minimum Burst Pressure Rating: 4 times the rated operating pressure

.9 Hoses shall bear manufacturer's identification and labeling as follows:

.1 SAE 100R classification and CRN

.2 Working pressure

.3 Manufacturer and Model No

.4 Date of fabrication

.10 Acceptable product:

.1 Aeroquip

.2 Continental

.3 Gates

.4 Goodyear

.5 Approved equivalent.

2.9 DISPENSING METERS (NOZZLES)

.1 Liquids:

.1 Electronic preset type.

.1 Replaceable alkaline battery powered

.2 Suitable for petroleum and synthetic liquids.

.3 Indoor use

.2 Working pressure:

.1 To suit application; minimum rating: 69 bar (1,000 psi)

.3 Flow rate: to suit dispensing pump outlet – refer to schedules

.4 Units of measure: selectable: litres, pints, quarts, gallons

.5 Acceptable product:

.1 GRACO

.2 Approved equivalent.

.2 Grease:

.1 Electronic metering

.2 Replaceable alkaline battery powered

.3 Indoor use

.4 Suitable for grease up to NLGI#2

.5 Working pressure:

.1 Minimum rating: 345 bar (5,000 psi)

.6 Flow rate: to suit dispensing pump outlet – refer to schedules

.1 Units of measure: Confirm SI or Imperial measurements with City.

.7 Acceptable product:

.1 GRACO LDP5 / PM

.2 Approved equivalent.

2.10 SPILL BOX FILLING CABINET AND ACCESSORIES

.1 Single shared cabinet for Engine Oil and Engine Coolant

.2 Refer to the drawings.

.3 Cabinet shall be equipped with spill containment

.1 Minimum 19 litres (5 USGal.) of liquid

.2 Drain connection.

.1 Lockable hinge mounted lid.

.4 Audible tank overfill protection, two in total (each can support up to four (4) tank) similar to SAMSON Model # 5264-A

2.11 PIPE, FITTING AND VALVES

.1 Waste Oil, Waste Coolant, Windshield Washer Fluid, Engine Coolant:

.1 Pipes: Carbon Steel for all size, ASTM A106 Gr.B, Schedule 40 seamless.

.2 Fittings:

.1 NPS 2 and smaller: Malleable iron, threaded, class 2000.

.2 NPS 2 ½ and larger: Buttweld or flanged (raised face).

.3 Joints:

.1 NPS 2 and smaller: threaded, class 2000.

.2 NPS 2 ½ and larger: Welded connection or flanged

.4 Valves: Ball type for all sizes, WOG, Carbon steel Body, PTFE seat:

.1 NPS 2 and smaller: threaded, class 3000.

.2 NPS 2 ½ and larger: flanged, class 150.

.5 Flexible hose: Synthetic rubber tube, Braided wire reinforcement, synthetic rubber cover:

.1 Waste Oil and Waste Coolant pump connections

.1 Performance to SAE 100R4:

.2 Maximum Operating pressure rating: 250 Psi

.3 Minimum Burst pressure rating: 1000 Psi

.4 Operating Temperature rating: -40° to 100°C

.5 Manufacturer: Aeroquip Model No. 2661 AQP.

.2 Engine Coolant and Windshield Washer Fluid pump connection

.1 Performance to SAE 100R6:

.2 Maximum Operating pressure rating: 400 Psi

.3 Minimum Burst pressure rating: 1600 Psi

.4 Operating Temperature rating: -40° to 100°C

.3 Acceptable product:

.1 Aeroquip

.2 Continental

.3 Gates

.4 Goodyear

.5 Approved equivalent.

.2 Engine Oil:

.1 Pipes: Carbon Steel for all size, ASTM A106 Gr.B, Schedule 80 seamless.

.2 Fittings:

.1 NPS 2 and smaller: Malleable iron, threaded, class 3000.

.2 NPS 2 ½ and larger: Buttweld or flanged (raised face).

.3 Joints:

.1 NPS 2 and smaller: threaded, class 3000.

.2 NPS 2 ½ and larger: Welded connection or flanged

.4 Valves: Ball type for all sizes, WOG, Carbon steel Body, PTFE seat:

.1 NPS 2 and smaller: threaded, class 3000.

.2 NPS 2 ½ and larger: flanged, class 300.

.5 Flexible hose: Performance to SAE 100R16, Synthetic rubber tube, Braided wire reinforcement, synthetic rubber cover:

.1 Maximum Operating pressure rating: 15.5 MPa (2250 psig)

.2 Minimum Burst pressure rating: 62 MPa (9000 psig)

.3 Operating Temperature rating: -40°C to 100°C

.4 Acceptable product:

.1 Aeroquip

.2 Continental

.3 Gates

.4 Goodyear

.5 Approved equivalent.

.3 Grease (All components shall be rated for working pressure of 34.5 MPa (5000 psig):

.1 Pipe:

.1 NPS 1 ½ and smaller: Carbon Steel, Schedule XXS, ASTM A106, Grade B, seamless.

.2 Fittings:

.1 NPS 1 ½ and smaller: Forged steel socket weld, class 9000.

.3 Joints: All welded. threaded connection permitted at branch end and valves only.

.4 Valves: High Pressure Carbon Steel 2-Piece Ball Valve, wrought carbon body, seal-welded, rated for 41.4 MPa (6,000 psig) (WOG), threaded connection.

.5 Flexible hose: Synthetic rubber tube, Braided wire reinforcement, synthetic rubber cover;

.1 Grease pump connection- ½", Performance to SAE 100R11:

.1 Maximum Operating pressure rating: 53.0 MPa (7700 psig)

.2 Minimum Burst pressure rating: 212.3 MPa (30800 psig)

.3 Operating Temperature rating: -40° to 100°C

.4 Acceptable product:

.1 Aeroquip

.2 Continental

.3 Gates

.4 Goodyear

.5 Approved equivalent.

.2 Grease Dispenser connection- ¼", Performance to SAE 100R16:

.1 Maximum Operating pressure rating: 5000 Psi

.2 Minimum Burst pressure rating: 20000 Psi

.3 Operating Temperature rating: -40° to 100°C

.4 Acceptable product:

.1 Aeroquip

.2 Continental

.3 Gates

.4 Goodyear

.5 Approved equivalent.

3 Execution

3.1 INSTALLERS

.1 Installation performed by certified pipe fitters.

3.2 PREPARATION

.1 Lay out work in accordance with lines and grades as indicated.

.2 Verify lines, levels, dimensions as indicated against established benchmarks. Report discrepancies to Citys's representative and obtain written instruction.

.3 Adjust pipe route and/or equipment location to avoid conflicts with new and/or existing.

.4 Provide sufficient clearance for routine maintenance of new and/or existing equipment.

.5 Where pipe/equipment installed obstructs maintenance access to other services, relocate as instructed by City's representative.

3.3 INSPECTIONS

.1 Leave joints in piping systems uncovered until tests completed and system inspected and approved by City's representative.

.1 Perform Non Destructive weld testing according to code and requirements of the Authority Having Jurisdiction (AHJ).

.2 AHJ to inspect new piping prior to hydrostatic pressure tests for compliance with reviewed drawings and specifications.

.3 Obtain from City's representative the requirements for inspection and testing of system modifications, design changes and repairs performed in house.

.4 Pay all costs for inspections performed by jurisdictional authority.

.5 Perform, at no additional cost to City, radiographic or ultrasonic testing of all welds failing visual inspection.

.6 Coordinate installation and testing activities with inspection requirements of the AHJ. At minimum:

.1 Schedule regular inspection of any system component before installation.

.2 Schedule regular inspection of all welds and joints as they are made.

.3 Provide AHJ with credentials of all workers.

.4 Conduct all tests required by AHJ to prove welder qualified to perform applicable welding procedure(s).

.5 Provide AHJ with any additional documentation requested to demonstrate piping system components are suitably rated.

.6 Schedule with AHJ to witness all pressure tests performed.

.7 Correct noted AHJ construction deficiencies to satisfaction of the AHJ at no additional cost to the City

.8 Retest any system to satisfaction of AHJ at no additional cost to the City.

.9 Put no system governed by Boilers and Pressure Vessels Act into service until approval granted by the AHJ.

.7 Provide personnel lift and trained operator for inspection of installed work. Provide safety harnesses to all personnel.

3.4 INSTALLATION – GENERAL

.1 Install all systems required governed by the Boilers and Pressure Vessels Act to latest requirements of CSA B51 – Boiler, Pressure Vessel, and Pressure Piping Code, and all related codes and standards governing selection and installation of piping, fittings, joining methods, welding, valves, etc.

.2 Clean piping before installation. Remove rust and scale. Deburr pipe after cutting and chips after threading.

.3 Clearances:

.1 Maintain clearance around systems, equipment and components and between pipes and structures for Operation and Maintenance, as directed and to manufacturer's recommendations, for greater of:

.1 Observation of operation, inspection, servicing, maintenance.

.2 Disassembly, removal of equipment and components without interrupting operation of other system, equipment, components.

.2 Where required locate valves to permit installation of thermal insulation of pipes.

.4 Coordinate location of piping, valves and reels with ductwork, lights, building structure, and all other services.

.1 Perform trial bus drive-in scenarios with the City to confirm locations prior to finalizing location of overhead hose reels.

.2 City shall provide bus and operator.

.5 Provide necessary clearance for maintenance. Identify potential interferences to the Contract Administrator for resolution.

.6 Flanges: Use suitable graphite lubricant on bolts and nuts.

.7 Drain valves:

.1 Install at all low points in piping systems, at equipment, at section isolating valves and elsewhere as required, whether shown on Contract Drawings or not.

.2 Weld couplings for drains into piping to ANSI/ASME B31.1M.

.8 Firestopping: Make provision for sealing piping passing through walls with approved firestopping compatible with surface temperature of pipe or insulation.

.9 Brace piping securely to building structure, where pipe movement occurs due to valve and/or pump operation. Submit attachment details for approval.

.10 Branch take-offs:

.1 Use welding tees, socket or butt only.

.2 Where reducing tees of proper size are unavailable, use available tees with reducers. Tees with increasers not acceptable.

.3 Weld lets not acceptable.

.11 Cap open ends of piping during installation. Remove foreign material from inside piping.

.12 Flanges: Tighten bolts evenly with torque wrench.

.13 Revisions to location of piping require approval by the Contract Administrator. Prepare and submit Drawings of all proposed revisions.

.14 Connections to equipment: Provide pressure rated unions where hose assembly does not include a swivel joint.

3.5 FABRICATION OF PIPING

.1 Codes: Perform work in accordance with ANSI/ASME B31.1M.

.2 Joints:

.1 At valves connected to hose reels or pumps: One only screwed joint permitted.

.2 Elsewhere: Welded throughout, except at flanged components.

.3 Screwed joints:

.1 Provide clean machine cut threads.

.2 Use approved compound on male threads.

.3 Permitted only at last fitting (valve) of each pipe run.

.4 Branch connections:

.1 Use butt or socket weld fittings only.

.2 Weldolets, threadolets, or half couplings not permitted.

.3 Pipe to pipe welded branch connections not permitted.

3.6 WELDING

.1 Perform welding in accordance with requirements of this Section.

3.7 HOUSEKEEPING

.1 Maintain good housekeeping of all materials, and take every precaution necessary to ensure products not inadvertently mixed between systems.

.2 Protect all product certification markings from soiling and damage during handling and installation. Install and orient all equipment, piping, fittings, hoses, and valves so certification markings remain visible for inspection.

.3 Do not paint, cover or conceal system piping, valves, hoses, fittings, and especially certification markings until all inspections and pressure tests conducted successfully and system approved for operation by AHJ.

3.8 PIPE SUPPORTS

.1 In strict accordance with Section 20 05 29, and requirements of this Section.

.2 Provide to details as indicated on Contract Drawings.

.3 Submit shop drawings for review before fabrication and installation.

.4 Percussion type inserts not permitted unless shown otherwise.

.5 Power driven fasteners not permitted unless shown otherwise.

.6 Neatly arrange piping on common trapeze type hanger, and route piping to avoid interference with other mechanical services, electrical lights and wiring and building structure. Provide equal spacing between each pipe. Allow sufficient space on hanger system for other mechanical piping (domestic hot and cold water, tempered water, non-potable water) and coordinate to provide neatest possible piping routing through garage.

.7 Install to manufacturer's recommendations.

.8 Install to details indicated on Contract Drawings.

.9 Provide and install additional structural steel to support piping located between truss lines. Submit details of attachment to building prior to proceeding with work. Arrange and pay for qualified trades.

3.9 VALVES

.1 Install valves as required to isolate all branch lines.

.2 Install only steel valves for all flammable and combustible fluids.

.3 Install isolating valves at branch take-offs, at pieces of equipment and elsewhere as indicated.

.4 Install in accordance with manufacturer's recommendations.

.5 Install in accessible locations.

.6 Depending upon piping configuration and ease of operation, on horizontal pipes install with stem horizontal or above.

.7 Valves accessible for maintenance without removing adjacent piping.

.8 Isolation valves in main runs or branches: Socket weld or flanged.

.9 Valves at hose connections: Screwed unless indicated otherwise.

3.10 STRAINERS

.1 Install in locations to allow easy access for removal of screen.

.2 Install before inlets to all meters, in suction line of pump.

3.11 PRESSURE TESTS

.1 Hydrostatic Pressure Test:

.1 Perform hydrostatic pressure tests on following systems:

.1 Grease distribution system.

.2 Engine Oil distribution system.

.3 Engine Coolant distribution system.

.4 Windshield fluid system.

.5 Waste oil.

.6 Waste coolant,

.7 Any other system governed by the Boilers and Pressure Vessels Act and Code.

.2 Conduct tests in presence of City’s representative, and as required by the AHJ.

.3 Give City and AHJ minimum of five (5) working days notice of intention to perform pressure tests.

.4 After installation and before concealing, perform hydrostatic pressure tests to 1.5 times maximum working pressure and maintain test pressure without loss or leaks for 24 hours.

.5 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or test media and indicate in test report.

.6 Bear costs for tests, for repairs or replacement, retesting, making good.

.7 Insulate or conceal work after approval and certification of tests by AHJ and City.

.8 Use test media indicated on Contract Drawings, and unless indicated otherwise, use fluid intended to be carried by each piping system.

.9 Supply new high quality accurately calibrated pressure gauges to verify test pressures, as specified under this Section. Submit bill of sale as proof gauges are new.

.10 Test gauges not new: Submit calibration certificate dated within one (1) month of test date.

.11 Replace all pressure gauges suspected to be faulty or out of calibration.

.12 Provide equipment that will safely and accurately generate test pressures, under controlled conditions, and without potential for human error. Submit proposed test equipment to City for approval.

.13 In accordance with above, test pressures may be generated as follows:

.1 Hydraulic hand pump (preferred).

.2 Piston pump controlled by regulated air supply.

.3 Electric pump with unloader or relief set to test pressure.

.4 Methods using on/off control of equipment to limit pressure not permitted.

.14 Any pressure test procedure found unsafe, in opinion of City representative of AHJ, will be cancelled and rescheduled at the Contractor's expense.

.15 Upon successful completion of pressure test for each individual pressure piping system, prepare and submit detailed test report.

3.12 PAINTING

.1 All painting performed by qualified trades.

.2 Do not cover pipe identification markings until City and AHJ have inspected them.

3.13 FLUSHING AND CLEANING

.1 Cleaning Solutions:

System	Clean/Flush with:
Grease	Safety Solvent
Engine Oil	Safety Solvent
Engine Coolant	Water
Windshield Fluid	Water
Compressed Air	Water/Air

.2 Timing: Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.3 Install products such as flow meters and dispensing valves only after cleaning certified as complete.

.4 Conditions at time of cleaning:

.1 Systems to be free from construction debris, dirt and other foreign material.

.2 Isolation valves to be operational, fully open to ensure terminal units can be cleaned properly.

.5 Engine Oil, Grease:

.1 Remove dispensers and meters from hose reels. Use isolation valve at each hose reel.

.2 For bulk stored products in ASTs, disconnect suction hose from pipe.

.3 Use safety solvent to flush each system.

.4 Charge each system with solvent.

.5 Dispense, at maximum flow, 100 L of solvent from each reel, working from closest to furthest reel from pump.

.6 At each reel, upon completion of flushing, sample solvent into bucket or strainer. If debris present, repeat flushing.

.7 Filter solvent of debris, reuse for other systems.

.8 Upon completion of flushing, blow piping dry with compressed air.

.9 Establish and follow procedures to control vapours from solvent to safe levels, in accordance with manufacturer's recommendation.

.10 Recover and recycle used solvent.

.11 Final Priming: Charge systems with respective products.

3.14 PRODUCTS FOR TESTING, FLUSHING AND CHARGING

.1 Purchase and supply all fluid products required for flushing of each system.

.2 Arrange for bulk/drum delivery of products as required to suit system and activity.

.3 Allow for disposal and/or recycling of waste product for each system.

.4 Where directed by City, reserve waste products for priming and testing of waste oil and/or waste glycol systems.

3.15 INSULATION

.1 Insulate and heat trace suction lines to tanks where indicated in accordance with Section 20 07 00 – Mechanical Insulation.

.2 Do not cover piping until pressure tests have been completed and witnessed.

3.16 COMMISSIONING

.1 Perform Commissioning in accordance with Sections 01 91 00.

.2 Verify operational performance in general conformance with the following outline:

.1 Engine coolant, windshield fluid, waste oil and waste coolant fluids (low pressure piping and fittings):

.1 Flushing and cleaning.

.2 Pressure test.

.3 Inspection of piping for excessive vibration.

.4 Flow rate achieved at each dispenser.

.5 Setpoint of each pressure relief valve.

.6 Setpoints of pump air supplies.

.7 Other.

.2 Engine oil (medium pressure piping and fittings):

.1 Flushing and cleaning.

.2 Pressure test.

.3 Inspection of piping for excessive vibration.

.4 Flow rate achieved at each dispenser.

.5 Setpoint of each pressure relief valve.

.6 Setpoints of pump air supplies.

.7 Other.

.3 Grease (high pressure piping and fittings):

.1 Flushing and cleaning.

.2 Pressure test.

.3 Inspection of piping for excessive vibration.

.4 Flow rate achieved at each dispenser.

.5 Setpoint of each pressure relief valve.

.6 Setpoints of pump air supplies.

.7 Other.

.4 Flow meters:

.1 Flow rate achieved at each dispenser.

.2 Other.

.3 Commissioning Method shall include:

.1 **Instrumentation:** Verify accuracy of pressure gauges by comparison with calibrated test instruments.

.2 Full scale tests:

.1 Upon completion, conduct full scale tests at specified operating pressure and air regulator setpoints.

.3 Dispense product at each dispenser for 30 seconds. Measure product dispensed. Calculate flow rate. If product flow excessive or inadequate, adjust air supply pressure.

.4 Reports.

3.17 START- UP OF PRESSURE SYSTEMS

.1 Timing: After:

.1 Cleaning is completed.

.2 Pressure tests are completed.

.3 Joints radiographed as specified.

.4 Painting and identification is complete.

.2 Provide continuous supervision during start-up.

.3 Set pressure controls.

.4 Ensure air is removed and piping is fully charged.

.5 Clean out strainers where installed.

.6 Check pressurization to ensure proper operation and flow at all dispensers.

.7 Check for leaks.

.8 Eliminate pipe vibration. Provide additional bracing to approval of City.

.9 Perform TAB as specified in Section 20 05 93. Adjust operating pressure to achieve specified flow rates at all dispensers.

.10 Adjust pipe supports, hangers, springs as necessary.

.11 Monitor pipe movement, performance of anchors.

.12 Check operation of relief valves.

.13 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

.14 Test operation of operating, limit and safety controls.

.15 Record pressure of air supply, pump supply and relief setting for each system.

.16 Fasten loose items of equipment to ensure quiet operation of system.

3.18 CERTIFICATES

.1 Complete and submit AHJ documentation.

END OF SECTION

1 General

1.1 SCOPE OF WORK

.1 Provide equipment and services necessary to complete the work for the automatic bus washing systems to provide the following washing:

.1 Exterior and undercarriage (chassis) wash: amount: 2

.1 Complete vehicle exterior wash system including all equipment, pumps, piping, valves, spray nozzles, and all miscellaneous items required to complete the work.

.2 Chassis (undercarriage) wash only: amount: 2

.1 Complete vehicle pre-wash undercarriage wash system including all equipment, pumps, piping, valves, spray nozzles, and all miscellaneous items required to complete the work.

.2 The systems shall also include but not limited to the following:

.1 Power and control systems complete with all control devices and control panels.

.2 Design, installation, testing, commissioning and training by a single specialized bus wash system supplier.

.3 Emphasis on environmental sustainability through the use of a recycled water system augmented by potable water system. The system shall be designed in conjunction with the water distribution system.

.4 Confirmation that the bus wash equipment is fully operational and functioning as intended by the manufacturer and the City, following Substantial Completion.

.5 Presence of at least one equipment manufacturer's qualified technician on site for a minimum of two weeks following Substantial Completion to assist, trouble shoot and adjust equipment as needed.

1.2 WARRANTY

.1 Equipment Warranty: Two (2) year extended warranty, commencing upon the date of the first wash, covering repair and/or replacement of equipment or material that causes any operational disturbances due to manufacturing defects or installation defects occurring within the extended warranty period.

.2 Frame Warranty: Ten (10) Year warranty on steel framework including galvanizing, welds and overall integrity.

2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design products are named in this Section; additional manufacturers offering similar systems may be incorporated into the work provided they meet the performance requirements established in this section.

.2 Acceptable Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Wesmatic (basis of design)

.2 Interclean

.3 Pseco

.4 or approved equal through a substitution approval request.

2.2 DESIGN AND PERFORMANCE REQUIREMENTS

.1 The automatic wash system shall be a heavy-duty, robust automated single direction drive through bus wash system.

.2 The System shall

.1 Be capable of washing the various configurations of the Winnipeg Transit bus fleet:

.1 Varying from approximately 10 meters to 30 meters in length,

.2 With front mounted bicycle racks.

.3 With rooftop mounted HVAC, and battery packs

.4 With Battery Electric Bus components including batteries and charging pantographs

.2 Complete the full washing operation and drying cycle within 2 minutes.:

.3 Be able to wash buses at a rate of up to 8 buses per hour, 24 hours per day, 365 days per year.

.3 The system shall control the wash process to provide a consistent wash result without relying on the judgment of individual drivers.

.4 The wash system shall be designed with adequate capacity to ensure that all wash lanes can operate concurrently.

.5 The wash system shall have a dedicated water meter with remote reading and BMS integration capability.

.6 The system shall be a drive-through unit for maximum efficiency with brushes and mops as required to friction wash the sides, front and rear, and to wash the roof of the bus.

.7 The design of the system shall respond to water characteristics (calcium content), water consumption, sewer discharge by-laws, energy consumption, and the City's commitment to environmental sustainability.

.8 This system shall be capable of washing the front, rear and sides of the transit buses with brushes several times on a single wash and include a special mirror protection program and special bike rack protection program.

.9 The system shall fully control the degree of brush pressure delivered to the bus and automatically adjust as required. Touchless wash systems or gantry type systems are not acceptable. Combination friction/touchless option is acceptable only for the front of the bus.

.10 The wash functions of this system shall be operated automatically and controlled by infra-red technology. The wash system shall regulate the washing action and speed of the drivers to maximize cleaning results while eliminating incidents of damage to buses or machine.

.11 Design equipment to facilitate connection and disconnection of conduit and accessories and such that all parts are easily accessible for inspection, operation and maintenance.

.12 The equipment located in the Mechanical Room shall preferably be skid mounted, with one skid containing all the supporting equipment for each wash system, including the water recycling system.

.13 The chassis wash system, whether stand-alone or integrated with a full exterior wash, shall be complete with an automatic (sensor triggered) high-pressure undercarriage wash system to remove excessive snow, ice, salt, sand and road grimes accumulation prior to regular wash station. Under-carriage spray shall have pressure adjustment capabilities.

.14 The full exterior wash system, excluding chassis wash, shall include but not be limited to the following features:

.1 Along with the other performance requirements, the systems shall be designed to:

.1 Minimize wear of bus paint or coatings, especially at corners.

.2 Provide full cleaning of the windshield, such that pre or post-cleaning is not required.

.2 Brushes:

.1 Brush pressure shall be self-monitoring and self-adjusting shall be pre-programmed automatically, prior to the commencement of each wash.

.2 Start and stopping of the brushes shall be achieved through infra-red photo cells, or similar non contact devices. Wand switches are not acceptable.

.3 Brushes shall have a provision of water and detergent delivery. The mixture of detergent to brushes shall be adjustable from the floor level allowing for adaptation to wash conditions. Piping and nozzles shall be stainless steel or galvanized steel.

.4 Brushes shall be deployed and retracted by electrical means. Compressed air actuation is not acceptable unless specifically approved by the City.

.3 Infra-red sensors, or other technology used, shall be controlled in such a manner as to not start the machine by pedestrian traffic.

.4 Entrance and exit from wash stations shall be complete with transparent PVC silhouette splash curtains.

.5 Glide plates shall be provided for guiding of vehicle at entrance of the guide rails.

.6 Stainless steel or galvanized steel tire guide rails shall be provided for the entire length of the pre-wash and wash station.

.1 The guide rails shall include a removable (bolted or slide in) section to allow forklift access into the adjacent equipment room.

.7 Water recycling system:

.1 Shall achieve the highest economical level of water recycling without the use of any chemical additives.

.2 Recycling of minimum 75% of total used water/wash cycle.

.3 Major components shall be made of stainless or galvanized steel or material proven to have equivalent durability for the intended purpose and environment

.4 Fresh water cross-over (in case of disrupted operation) and integration to rain water collection system shall be included.

.5 Used water quality shall be acceptable for discharge to the municipal sewage system in accordance with municipal by-laws.

.8 Bus drivers shall be directed throughout the entire wash process with LED-traffic lights. Lights shall interact and be a function of the control system. Traffic lights shall be contained in a CAS approved watertight enclosure.

.9 Each wash station shall have a wheel wash module designed with optimized high-pressure spray pattern to clean the vehicle wheels, rims and rocker panels.

.10 Controls:

.1 The system shall be equipped with self-diagnostic software that indicates any errors, malfunctions, or other stoppages via the LCD display screen. The nature of the shutdown shall be displayed on the control panel (LCD screen).

.2 The system shall include a counter that displays the number of washes performed, both collectively and in various programs chosen. The system is to contain the capability to perform numerous unique wash programs for differing wash choices. Alternate wash selections can be activated on a control panel prior to commencing the wash.

.3 Provide dry contact alarm interface to BAS.

.4 All electrical components shall be UL/ULC listed. All control panels shall be UL/ULC listed as a complete enclosed industrial control panel. All panels shall be stainless steel and constructed for use in wet environment.

.5 All electrical conduits shall be plastic or epoxy coated metal for use in wet environment.

.6 The main control box shall include a control panel with a LCD screen to provide the following standard functions:

.1 Drive through without wash.

.2 Program 1: With front wash for buses w/o bike racks (front, sides and rear wash-complete wash).

.3 Program 2: With front wash for buses with bike racks (front, side and rear - complete wash).

.4 Program 3: Sides only.

.5 Detergent arch “Off/On”.

.6 Alternate wash programs.

.7 Start wash machine “Enter”.

.8 Emergency stop.

.9 Emergency stop reset.

2.3 UTILITY REQUIREMENTS

.1 The following anticipated utilities will be provided. Manufacturer to identify requirements beyond the stated amounts.

.2 Water:

.1 39 mm to 50mm (1-1/2” - 2") cold water supply at 415 kPa (60PSI) feed with *backflow protection* to mutually agreed service areas such as the pump room and wash bay.

.3 Compressed Air:

.1 One 25mm (1"), with total of 60 LPS (28 CFM) dried air supply, with 19mm (3/4”) branches for each of two water recycling systems, to mutually agreed service areas such as the pump room and wash bay.

.4 Electrical (3-Phase):

.1 External / chassis wash system: per lane: 180 FLA @ 575 VAC x 2 lanes

.2 Chassis wash system only: per lane: 35 FLA @ 575 VAC x 2 lanes

.5 Water Recycle System:

.1 In-Ground Pits/Settling Tanks.

.2 In-Ground piping and conduit

.3 Pump(s) by wash supplier.

3 Execution

3.1 INSTALLATION AND TESTING

.1 The complete systems shall meet all applicable code requirements and safety regulations and shall be designed with personnel safety as the prime consideration.

.1 Installer qualifications: Engage an experienced Installer who is an authorized representative or employee of transit washing equipment manufacturer for both the installation and maintenance of the type of equipment required for this Project.

.2 Manufacturer qualifications: Firm experienced in manufacturing for transit washing equipment with a minimum of five systems in operation to this Specification and that have a record of successful in-service performance for ten years or greater.

.3 Electrical component standard: Provide components that comply with NFPA 70 “National Electrical Code” and are listed and labeled by ULC.

.2 Commissioning

.1 Equipment manufacturer shall provide final testing, acceptance, start-up and commissioning documentation such as water pressure tests, pumps pressure and vibration tests, controls tests, alarms tests, etc., After completion of the work as described above, the manufacturer shall provide a certificate of commissioning.

.3 Training

.1 Equipment manufacturer shall provide minimum 8 hrs of training for operators and provide training certificates upon training completion.

.2 Equipment manufacturer shall provide a program of preventive maintenance and provide minimum 24 hrs training for maintenance personnel.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes supply and installation of the following:

.1 Ceiling hung wash bay curtains, track and accessories required for a complete installation.

1.3 SUBMITTALS

.1 Product Data: Include construction details, material descriptions, accessories, dimensions of individual components and profiles, and finishes.

.2 Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, details, and attachments to other work.

.3 Samples for Initial Selection: For fabric indicated.

.4 Maintenance Data: For curtain to include in maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Store and handle curtain and accessories in a manner to avoid significant or permanent damage to fabric or frame.

.2 Comply with manufacturer's written instructions for minimum and maximum temperature requirements for storage.

1.5 PROJECT CONDITIONS

.1 Field Measurements: Indicate measurements on Shop Drawings.

.2 Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating without field measurements. Coordinate bracket construction to ensure that actual dimensions correspond to established dimensions.

1.6 COORDINATION

.1 Coordinate installation of anchorages for mounting brackets. Furnish setting drawings, templates, and directions for installing anchorages, including items with integral anchors that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.7 WARRANTY

.1 Equipment Warranty: Five (5) years extended warranty, commencing upon the date of the first wash, covering repair and/or replacement of equipment or material that causes any operational disturbances due to manufacturing defects or installation defects occurring within the extended warranty period.

.2 Frame Warranty: Ten (10) Year warranty on steel framework including galvanizing, welds and overall integrity.

2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design products are named in this Section; additional manufacturers offering similar systems may be incorporated into the work provided they meet the performance requirements established in this section.

.2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 AmCraft Manufacturing Inc.

.2 AKON LLC.

.3 or approved equivalent

2.2 MATERIALS

.1 Steel Plates, Shapes, and Bars: ASTM A36/A36M.

.2 Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from steel plate complying with ASTM A572/A572M, Grade 55 (380).

2.3 TRANSPARENT WASH BAY CURTAINS

.1 Solid curtains consisting of 20 mil clear vinyl, and the following characteristics:

.1 Tensile Strength (ASTM D882): MD 2900-3500 PSI; TD 260-300 PSI

.2 Elongation (ASTM D882): MD 270-310%; TD 260-300 %

.3 100% Modulus (ASTM D882): MD 1550-1950 PSI; TD 1800-2200 PSI

2.4 CURTAIN TRACK AND HARDWARE

.1 Material: Galvanized G-60 or better steel.

.2 Welded Areas: Commercial clear zinc plated steel.

.3 Track Material: 16 gauge commercial quality low carbon steel.

.4 Splices and Mounting Hardware: 10 gauge commercial quality low carbon steel.

.5 Curtain Trolleys:

.1 Wheels: Nylon 66 material, complete with steel ball bearing.

.2 Axels and Rivets: Zinc plated cold finished round bar steel.

.3 Hooks: Zinc plated cold finished round bar steel; 1” length.

2.5 ACCESSORIES

.1 Chain Weighted Bottom: Steel chain sewn into bottom hem of curtain, reducing movement in curtain.

.2 Tiebacks: Straps matching curtain material, to secure curtain off to side when retracked.

3 Execution

3.1 EXAMINATION

.1 Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of wash bay curtain.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Coordinate size and location of wash bay, and furnish anchoring devices with templates, diagrams, and instructions for curtain installation.

3.3 INSTALLATION

.1 Install curtains, including track and accessories as required for a complete installation, as recommended by curtain manufacturer.

.2 Bolted Attachment: Attach suspended track to structural support, at height to allow wash bay curtains to hang just proud of finished floor height.

END OF SECTION

1 GENERAL

1.1 RELATED SECTIONS

.1 The section specify the electric charging systems for Battery Electric Buses.

.2 Div 26, 27 and 28

1.2 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)

.1 CSA C22.2 No. 346:22 (R2022), DC Charging Equipment for Electric Vehicles.

.2 Open Charge Alliance (OCA):

.1 OCCP 1.6-J-2022, Open Charge Point Protocol 1.6-J (JSON over WebSockets).

.3 SAE International (SAE):

.1 SAE J1772-2022, Surface Vehicle Recommended Practice J1772, SAE Electric Vehicle Conductive Charge Coupler.

.4 Underwriters Laboratories Inc. (UL):

.1 UL 1773-2020, Standard for Personal Termination Boxes.

.2 UL 2231-1-2021, Personal Protection Systems for Electric Vehicle (EV) Supply Circuits, Part 1.

.3 UL 2231-2-2020, Personal Protection Systems for Electric Vehicle (EV) Supply Circuit: Particular Requirements for Protection Devices for Use in Charging Systems.

.4 UL 2594-2016, Standard for Electric Vehicle Supply Equipment.

1.3 SUBMITTALS

.1 Outline sketch with dimensions showing arrangement of charging cubicles, charging dispensers and any associated equipment.

.2 Shipping weight.

.3 Schematic diagram showing components and the interconnecting cables.

.1 If different from the infrastructure outlined on the drawings, include a drawing detailing the alternative equipment layout and all the raceways.

.4 Charger data: type and capacity, battery charging sequence, estimated noise level, metering, alarms, interfaces, controls and efficiency.

.5 Charger cabinet and dispenser cabinet installation instructions.

.6 Charger cabinet and dispenser cabinet testing and commissioning instructions.

.7 Charger cabinet and dispenser cabinet operation and maintenance instructions.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for EV charger for incorporation into manual.

.2 Operation and maintenance instructions covering design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance and repair.

.3 Copy of approved shop drawings.

.4 Technical description of components.

.5 Parts lists with catalogue numbers and names and addresses of suppliers.

1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Manufacturer regularly engaged in the manufacture of electric vehicle chargers of the types and sizes required, whose products have been in satisfactory use in similar service in Canada or North America for not less than five years.

.2 Electric Vehicle Chargers: Comply with requirements of applicable local codes, as well as cUL, and CSA standards pertaining to electric vehicle chargers.

.1 Electric vehicle chargers cETLus Listed to CSA C22.2 No. 346:22.

1.6 EXTRA MATERIALS

.1 Provide maintenance materials.

.2 Provide one spare set of filters for each of the EV charging cabinets.

.3 Provide complete set of proprietary tools (if any) necessary to maintain and adjust every serviceable part of the EV charger and EV charging dispenser assembly.

.4 Provide software and proprietary cable(s) (if applicable) required to adjust configuration of the EV charging equipment.

2 PRODUCTS

2.1 CHARGER CABINET CHARACTERISTICS

.1 Input: 277/480V AC, 3 phase, 3 wire, grounded 60 Hz.

.2 Input power factor: >0.95

.3 DC output: 0-1000VDC, 150kW minimum, 200kW maximum.

.1 Where a different output is provided, charging system shall be configured to deliver up to 200kW to an individual dispenser.

.4 Auxiliary output: 120VAC/208VAC.

.1 If the charger does not provide auxiliary output power and supply new matching 120/208V 100A 3Ph 4W 44CCT (min) 22KAIC panelboard cw 15Kva (min) transformer fed out of a new matching breaker in the main building distribution. Size

panelboard to accommodate all EV charging dispensers, as well as all future EV charging dispensers, based on the equipment provided under this contract.

.5 Communication via multimode dielectric fiber or STP CAT6.

.6 One charger capable of supporting four (4) charging dispensers, operating in priority (prioritize dispensers in a pre-configured sequence), while limiting the load per charger cabinet to minimum 150kW output to maximum 200kW output.

.1 Contractor may propose an alternative equipment configuration, providing:

.1 The proposed equipment configuration fits within the physical space allocated for the chargers, as indicated on the drawings.

.2 The proposed equipment configuration limits the overall charging system demand without the need for licensed software subscription.

.3 The proposed equipment configuration is capable of charging the buses on a schedule equivalent to that of a sequential 4-dispencer system.

.4 The proposed equipment configuration is designed to provide up to 200kW of charging power at each charging dispenser.

.2 Contractor to submit the alternative equipment configuration for The City's review minimum one week prior to the tender closing date.

.7 Dead front free standing sheet steel, minimum 2.5 mm thick, sprinkler proof.

.8 Access from front only.

.9 Stop buttons and emergency stop button mounted on the front panel and provision for additional remote stop buttons.

.10 Include provisions in the cabinet and provide wiring diagrams for remote group emergency stop button capable of stopping the charging to groups of chargers.

.11 Indicators on the front panel of the unit to indicate charging status, system status, troubles and errors.

.12 Apply finish in accordance with manufacturer's standard.

.13 Operating temperature: -25 degrees C to +45 degrees C, up to 95% relative humidity.

.14 Minimum efficiency: 95.5%

.15 Maximum weight: 1500kg per cabinet.

.16 Total quantity: 6

.17 Include mental stands, cover plates and cable glands as required to permit cables to be routed from the bottom of the cabinet and through the sides.

2.2 CHARGING DISPENSER CHARACTERISTICS

.1 DC output: 100 to 1000VDC; up to 200kW, 99.5% efficiency.

.2 Auxiliary Power Supply AC input: 120 or 230VAC, 1ph

.3 Maximum auxiliary energy consumption: 500W

.4 Operating temperature: -25 degrees C to +45 degrees C, up to 95% relative humidity.

.5 Wall mounted configuration.

.6 Access from front only.

.7 Indicator lights or HMI interface to relay charging status, system status, troubles and errors.

.8 Charging port: CCS Type 1 / SAE J1772.

.9 CCS Cable Length: 7 meters.

.10 Cable specifications:

.1 Number of cores: 1

.2 Cross Section: 3/0AWG – 350MCM

.3 Min-max external diameter to fit through gland: 0.87 – 1.26 Inch

.4 Shielding: No

.5 Conductor: Tinned copper or aluminum conductor, fine wire, stranded acc. To VDE 0295 cl.5/IEC Cl.5

.6 Insulation: Special rubber or PVC (outdoor use, UV-protected, oil resistant)

.7 Minimum Nominal Voltage: 600/1000VAC, 900/1500VDC

.8 Minimum Test Voltage (AC): 6kV

.9 Ambient Temperature Range: -40 degrees C to 105 degrees C, permissible conductor operating temperature +90 degrees C

.11 Suitable for floor and wall mounting with dispenser cable suspended with cable retractor.

.12 Cable retractor for each dispenser is not limited to EV charger supplier. Cable retractor to be submitted and approved by Contract Administrator.

.13 Provide emergency stop button to the Depot Charge Box that is accessible.

.14 Total quantity: 24

2.3 EQUIPMENT IDENTIFICATION

.1 For major components such as input breakers, output breaker: size 4 nameplates.

.2 For mode lights alarms, meters: size 2 nameplates.

2.4 ACCEPTABLE MANUFACTURERS

.1 ABB.

.2 Siemens.

.3 Hitachi.

.4 Or approved equivalent.

3 EXECUTION

3.1 INSTALLATION

.1 Configure EV chargers in coordination with The City:

.1 Review all available charger features and functions with The City.

.2 Document The City's setting preference and include copy of the preferences in the O&M manual.

.3 Where charger settings can be backed up to a portable media, provide the City with a digital copy of the settings.

.2 Interface all EV chargers with DDC system to report charger alarm / trouble via a dry contact. Assign one input per charger on the DDC system.

.1 Supply all the necessary hardware and enclosures to interface the EV chargers with the DDC system.

.2 Ensure sufficient space within the enclosure to accommodate hardware required for the interface with future EV chargers.

3.2 CLEANING AND PROTECTION

.1 Not applicable

3.3 TESTS

.1 Test EV charging cabinet and dispenser cabinet in accordance with manufacturer's recommendations.

.2 Engage electric bus manufacturer representative to assist with the testing. Pay all associated fees.

.3 Conduct multiple bus charging tests by connecting a single electric bus to the EV charging cabinet via a single dispenser, with bus battery level at 20%, 50%, 70%, and 80%.

.1 Allow the bus to charge to 90% during each test.

.2 During the charging process, monitor and record all parameters recommended by the EV charging cabinet manufacturer.

.3 During the charging process, monitor and record all parameters recommended by the EV bus manufacturer.

.4 Document the above information, as well as charge start time, charge end time, ambient temperature at the location of the bus, EV charger power draw (recorded every 5 minutes) and names / signatures of the individuals performing and witnessing the testing.

.4 Conduct multiple bus charging tests by connecting four electric buses to the EV charging cabinet via four dispensers, with the battery status as outlined below.

.1 Allow all buses to charge to 90% during each test.

.2 During the charging process, monitor all parameters recommended by the EV charging cabinet manufacturer.

.3 During the charging process, monitor all parameters recommended by the EV bus manufacturer.

.4 Document the above information, as well as charge start time, charge end time, ambient temperature at the location of the bus, and names / signatures of the individuals performing the testing.

.5 Test the following bus configurations:

.1 All buses at 20%.

.2 All buses at 80%

.3 1st and 3rd bus at 20%, 2nd and 4th bus at 80%.

.6 Allow five business days of on-site assistance by EV equipment manufacturer representative to assist The City with testing of the EV buses in conjunction with the EV charging equipment.

.1 The days may be used concurrently or individually, at The City's discretion.

3.4 WARRANTY

.1 Minimum warranty on the EV charging cabinets and the associated dispensers shall be two (2) years from the date of substantial completion post installation.

.2 Contractor to provide separate price to extend the warranty on EV charging cabinets and the associated dispensers to five (5) years from the date of substantial completion.

3.5 TRAINING

.1 The Successful bidder must provide a minimum of 120 hours training at the property of the Winnipeg Transit for all levels of staff, per award of RFP plus any additional training required due to technological changes passed on to the HRM on any new component and/or new technology not presently used by the Winnipeg Transit.

.2 The Successful bidder will provide a list of training options available, including that provided by sub-vendors, plus associated costs, if any. The Winipeg Transit will select from the list, as it deems necessary, any training required

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Provide equipment and services necessary to complete the Work for the Bus Interior Vacuum System including but not limited to the following:

.1 One complete bus vacuum system with dual power units (duty/standby), 4 motorized hose reels with capabilities of running 4 reels simultaneously ; including all equipment, vacuum pumps, piping, air valves and all miscellaneous items required for a complete system.

.2 Power and control systems complete with all control devices and control panels.

.3 HEPA filtration for recirculation of air into the work area.

.4 Final testing, acceptance, start-up and production commissioning. Provide standby time at system start-up; minimum two days (four shifts) not less than one electrician, one pipefitter and one field superintendent.

.5 All piping, power and controls between various vacuum equipment components shall be installed by the vacuum equipment supplier.

.2 This Specification and equipment layout are based on Clean Air Technologies (EUROVAC) equipment or accepted equal.

.3 Equipment manufacturer shall allow for 2 weeks of site presence during the peak service lane shift, daily from 6pm to 2am, after substantial completion, for at least one technician to trouble shoot and adjust equipment as needed.

2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design products are named in this Section; additional manufacturers offering similar systems may be incorporated into the work provided they meet the performance requirements established by the named products.

.2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis of- -Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Clean Air Technologies Inc., Eurovac

2.2 SYSTEM DESCRIPTION

.1 The system shall be a central vacuum system designed for coarse and fine cleaning of transit vehicles. A maximum of 4 reels can simultaneously run at one time.

.2 Maximum radiated noise level shall not exceed 85 dBa at one meter

.3 The system shall be capable of handling wet or dry refuse. The system shall be able to collect course refuse like mud, leaves, sand, wrappers and transfers, from grooved bus floors and drivers' area while preventing fine dust from contaminating electrical and mechanical components.

.4 Filter separators shall be complete with venting, flame quencher, backflow preventer on filter separator inlet and other features in accordance with NFPA-68 and NFPA-69.

.5 The system shall be capable of fine cleaning such areas as radio compartments, electronic destination sign area, wheelchair lifts, and fare boxes, etc. without causing damage to the components.

.6 The system shall be complete with vacuum pumps, pre-separators with refuse containers (tilt dumpster type), pulse-jet filter separators, 4 remote controlled hose reels, and automatic vacuum shut off air valves, piping and programmable logic controller type electrical system.

.7 Each hose reel station shall have 15.24 m of 50 mm hoses c/w cleaning lances and attachments.

.8 A wireless remote control unit shall be provided for the hose reels.

.9 The system shall include automatic air valves, piping and programmable logic controller type electrical system. The system is designed to facilitate cleaning of the interior during the normal fueling cycle. The debris is pneumatically conveyed to the dumpster.

.10 Provide all material, equipment, labor, services and incidentals for a complete operable system. The Transit Authority shall approve final layout of all equipment and related structures.

.11 Features/Construction

.1 Vacuum pumps:

.1 Refer to the schedules.

.2 Two (duty/standby) Multistage vacuum pumps. Single stage fans or turbo pumps are not acceptable.

.3 Electronic surge control vacuum relief valves shall be provided to ensure the pumps receive cooling air and that the correct balance is maintained in the system.

.4 The vacuum pump inlet/outlet diameter shall be a minimum of 125 mm.

.5 The pumps shall operate at 575 volt, 3-phase, 60 Hz power.

.6 The vacuum pumps shall operate at a sound level not to exceed 80 decibels at a distance of 3 m.

.7 The vacuum pumps shall have a back flow valve on the outlet to eliminate risk of back flow of air through the other pump.

.8 Motors shall included thermal overload protection.

.2 Pre-separator:

.1 One high efficiency 450 diameter cyclone pre-separator shall be supplied suitable for separation of dry or wet refuse to a 90% at 10 microns.

.2 Complete with:

.1 Floor based mounting frame.

.2 Four point pneumatically operated bin lid with controls,

.3 Ultrasonic bin level detectors

.4 Sprinkler ports.

.5 Rear guide tracks to locate and retain separator under the pre-separator unit.

.3 Pre-separator shall have a clean-out door located at the bottom of the cone section for easy inspection and maintenance.

.4 Two front load dumpsters shall be furnished:

.1 1.4 cubic meter tilt dumpster

.2 Capable of being dumped by a fork lift into a refuge container.

.3 A viewing window shall be provided with a minimum of 2540 square mm viewing area, not less than 6 mm in thickness.

.4 Casters shall be steel type with two fixed and two swivels with locking brakes.

.5 Each dumpster shall withstand a vacuum of 3 m of water gauge negative pressure.

.5 Basis of Design Model:

.1 Eurovac Model PRS-30 – 854 D20

.2 Approved equal through a substitution approval request.

.3 Filter separators:

.1 The filter unit shall be a two-stage separator with a cyclonic primary separation trough the inlet and secondary separation through a series of pleated cartridge filters.

.1 The service life of the pleated polyester cartridge filters shall be a minimum of nine months.

.2 Sock type filters are not acceptable.

.2 The filters shall be cleaned both online and offline by a compressed air reverse flow pulse-jet system, automatically controlled, with manual override.

.3 Top mounted explosion relief valve with burst indicator (to meet NFPA and Local Codes)

.4 Inlet back flow prevention for an ST2 dust (to meet NFPA and local Codes)

.5 Sprinkler ports located on both clean and dirty side of collector.

.6 Basis of Design:

.1 Eurovac Model: 850dia BIBO Model FPRS-42 ERV by Eurovac,

.2 Approved equal through a substitution approval request.

.4 Final Filtration:

.1 Final filtration shall be included for each power unit prior to discharge of the air.

.1 Filtration shall at a minimum:

.2 Capture 90% or more of particles of size 3.0 to 10.0 micron, as determined by ASHRAE test methods, or approved equivalent test.

.3 Limit dust released to less than 5mg / cubic meter.

.5 Workstations:

.1 Each bus lane workstation located at the service lanes shall be equipped with one motorized ceiling mounted hose reel wireless remote controlled in-out with 15.24 m minimum 50 mm dia. antistatic hose located as indicated in Service (Fueling) Lanes standard process workstation schematic, with a pneumatic shutter valve to shut the vacuum off when the hose re-tracked back to the home position.

.1 The hoses shall be mounted on a motorized hose reel.

.2 All hose reels shall be wireless remote controlled for “UP” and “DOWN” by a controller fixed on the adjacent wall.

.3 The reel drum shall be 304 SS fixed to two HRS 16 gauge formed ends, with hose guides and not exceed 25 RPM gear motor revolution.

.4 A quick disconnect clean-out shall be provided on the hose reel outlet with a minimum opening of 100 mm.

.5 The hose reel shall be ceiling mounted on a steel frame engineered to hold the maximum weight of the reel. Reel to be located at a height such that interference with other equipment in the area (i.e. fueling Zimmerman rail) will be avoided.

.6 The cleaning lances shall be of aluminum with a minimum inside diameter of 50 mm for each workstation.

.7 The cleaning lance shall have a minimum wall thickness of 062 inches and be equipped with a replaceable brush tip.

.8 The wireless controller shall be positioned within finger reach on the cleaning lance in a plastic protective cover.

.9 The brushes shall be easily changed in no more than five minutes.

.2 Basis of Design:

.1 Model HR-2-50 by Eurovac,

.2 Approved equal through a substitution approval request.

.6 Full Bin Indicators:

.1 Ultrasonic precision proximity sensor.

.2 130 to 300 kHz operating range.

.3 Adjustable null and span.

.4 High performance stainless steel sensor head.

.5 High background noise suppression, temperature compensated.

.6 Suited for dry dusty environments, but resistant to moisture from wash down operations.

.7 Provide one sensor to indicate full tote bin, and one additional sensor for "high alarm" in the event the first sensor fails.

.7 Hose reel control stations:

.1 Control station located at each hose reel shall:

.1 Have a system STOP and START push button

.2 Green LED run light for the vacuum motor,

.3 Hose reel UP - DOWN momentary push button and

.4 Red raised mushroom head EMERGENCY STOP push button.

.2 Push buttons and indicator lights shall be industrial heavy duty type or approved equal.

.3 The hose reel control station shall be minimum NEMA 4 rated or selected for the appropriate application and location.

2.3 TUBING AND FITTINGS

.1 Manufacturer shall provide seamless galvanized steel piping and fittings for both the main and trunk lines. Also provide all joint compression fittings, valves and adapters for a complete and operable system.

.2 Pipe diameter at the gross refuse pick-up point shall be a minimum of 50 mm for fine cleaning.

.3 A minimum velocity of 1675 meters per minute shall be maintained in the main lines to prevent settling of refuse.

.4 Tubing and fittings:

.1 Galvanized Steel

.2 125 mm diameter or above shall be a minimum of 2.0 mm thick

.3 100 mm diameter or less shall be 16 gauge

.4 Clean outs mounted not further than 2000 mm c/c.

.5 Hand held and floor sweep inlets shall have inlet dimensions smaller than the smallest respective tubing diameter. This will reduce clogging of the piping system.

.6 Fittings: long sweep type and standard design.

Joints: securely joined with compression couplings, easily removable for cleaning using three-bolt rubber compression coupling or approved equivalent. All joints, valves, couplings, adapters and fittings shall be leak free and grounded.

.7 Hangers:

.1 Maximum spacing 3 metres on centre for horizontal runs.

.2 At each floor for vertical runs.

.3 Rigidly support and secure all elbows to the building structure.

2.4 CONTROL PANELS

.1 All controls, starters, push buttons, and associated devices shall be housed in a NEMA 4 - stainless steel enclosure to suit the garbage room environment.

.2 Remote indication of bin vent filter loading shall be provided in control panel front face. Provide indicating lights to show operation of each motor in garbage collection system.

.3 Each panel shall be complete with lockable disconnect fused or non-fused to suit the requirements of the installation.

.4 Main control panel shall be PLC based.

.5 Provide dry contacts in control panel to Building Automation System to indicate:

.1 System Running

.2 Dirty Filter

.3 Broken Filter

2.5 SAFETY REQUIREMENTS

.1 The complete system shall meet all applicable code requirements and safety regulations and shall be designed with personnel safety as the prime consideration.

.2 All belts, chains, drives shall be totally enclosed.

.3 Sharp edges on sheet metal panels, guards, frames, etc. shall not be allowed.

.4 All controls shall be clearly and permanently marked.

.5 All exposed parts subject to electrical energizing are insulated, enclosed or guarded.

.6 Maximum radiated noise level shall not exceed 85 dBA at 1 m.

3 Execution

3.1 INSTALLATION AND TESTING

.1 The complete system shall meet all applicable code requirements and safety regulations and shall be designed with personnel safety as the prime consideration.

.1 Installer qualifications: Engage an experienced Installer who is an authorized representative or employee of the bus vacuum system manufacturer for both the installation and maintenance of the type of equipment required for this Project.

.2 Manufacturer qualifications: Firm experienced in manufacturing of bus vacuum systems with a minimum of five systems in operation for this type of application, and that has a record of successful in-service performance of ten years or greater.

.3 Electrical component standard: Provide components that comply with the CEC – Canadian Electircal Code, NFPA 70 -National Electrical Code" and are listed and labeled by ULC or CSA.

.2 Commissioning

.1 Equipment manufacturer shall provide final testing, acceptance, start-up and commissioning documentation such as vacuum pressure tests, vacuum pumps pressure and vibration tests, controls tests, alarms tests, etc., After completion of the work as described above, the manufacturer shall provide a certificate of commissioning.

.3 Training

.1 Equipment manufacturer shall provide minimum 4 hrs of training for Service Lanes operators and provide training certificates upon training completion.

.2 Equipment manufacturer shall allow for 2 days' of site presence after Substantial Completion, by at least one technician for troubleshooting and equipent adjustment as required during the peak service lane shift.

.3 Equipment manufacturer shall provide a program of preventive maintenance for and provide minimum of 2 separate 4 hour training periods for maintenance personnel.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes fall protection system incorporating a horizontal lifeline system including travel restraint, and roof anchors for a limited zones on the roof that are greater than 8 m in height from adjacent roof areas unless otherwise indicated.

1.3 DESIGN REQUIREMENTS

.1 Design permanent anchors and lifeline systems in accordance with CAN/CSA-Z259 series and local authorities having jurisdiction to suit building design and areas indicated. Provide for maintenance access to roof edge.

.2 Design fall arrest safety anchors to CSA Z271- Safety Code for Suspended Elevating Platforms and a maximum fall arresting force of typically 4.5 kN (1,010 lbs.) when wearing a shock absorbing body harness with a safety factor of 2 without any permanent deformation and to 22.24 kN (5,000 lbs.) against fracture or detachment.

.3 Seismic Loads: Design and size components to withstand seismic loads as calculated in accordance with applicable code.

.4 Coordinate support requirements of building's structure for anchors of work of this Section. Ensure supports and the structures to which they are attached are designed to support 4.45 kN (1,000 lbs.) vertical service load plus impact with a factor of safety as per referenced standard and applicable codes, and to 4 times the rated load against fracture or detachment.

1.4 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings showing and describing in detail, anchor layout plans, materials, finishes, dimensions, details of connections and fastenings, elevations, plans, sections, metal thicknesses, hardware and any other pertinent information.

.2 All shop drawings shall bear the seal and signature of a Professional Engineer registered to design structures in the place of the Work, and employed by the fabricator/installer executing the work of this Section.

.2 Test Data:

.1 Submit test data showing that the materials shall meet the specified performance with fall arrest anchor reports as specified herein.

.3 Samples:

.1 Submit two (2) samples of each of the following for review of the Contract Administrator;

.1 Safety log book.

.2 Work plan acrylic protection cover.

.4 Fall Arrest Anchor and Travel Restraint Reports:

.1 Submit reports including copies of, but not limited to the following:

.1 Approved work plans, anchor details, test data, special liability insurance certificate, warranty certificate and "letter of acceptance" from the local authorities having jurisdiction and the Ministry of Labour.

.2 Include reports in the Operation and Maintenance Manuals.

1.5 CLOSEOUT SUBMITTALS

.1 Maintenance Data:

.1 Two copies of a reduced size as-built shop drawings showing equipment locations and details, for posting near accesses or exits to roof. Laminate documents in clear plastic.

.2 Include complete written and illustrated instruction manuals relative to the care, adjustment and operation of all parts of the equipment, a complete description and listing of components, with recommended frequency of service and maintenance to ensure maximum efficiency, reliability and long life of the equipment

.2 Field Inspection Documents: Include Inspection Log Book, with Initial Inspection - Certification for Use document, and completed Inspection Sign-Off.

1.6 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store materials in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

.4 Unsatisfactory or damaged materials shall be identified and removed from the Site.

.5 Adequately protect the structure and work of other Sections during delivery, storage, handling and execution of the work of this Section. Repair and /or replace damaged work of other Sections caused by the work of this Section at no additional cost to the Contract Administrator.

.6 Provide tools, plant and other equipment required for the proper execution of the work of this Section.

1.7 QUALITY ASSURANCE

.1 Installation and Design Responsibility: Execute work of this Section by a firm thoroughly conversant with laws, by-laws and regulations which govern, and capable of workmanship of best modern shop and field practice known to recognized manufacturers specializing in this work.

.2 Have work of this Section engineered by a professional engineer registered in the Province of the Work. Be responsible for:

.1 Layouts and quantities, to requirements of the authorities having jurisdiction, and CSA-Z91.

.2 Co-ordination and ensure compatibility with attaching structure.

.3 Obtain necessary permits and approvals from the authorities having jurisdiction.

.4 Installer Qualifications: Trained and approved by the manufacturer and having a minimum three years' experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.

.5 Maintenance and Operation Seminars: Engage a factory authorized service representative to train the City's maintenance personnel on proper procedures and schedules for adjusting, operating, troubleshooting, servicing, and maintaining the work.

.6 Pre-Installation Meeting: Two weeks prior to commencing work of roofing sections, arrange for manufacturer's technical representative to visit the site and review preparatory and installation

procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.7 Manufacturer's Site Inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. Submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.8 Source Limitations: Obtain each type of product from a single manufacturer.

2 Products

2.1 MATERIALS

.1 Steel Shapes, Plates: CAN/CSA-G40.20/G40.21-M, Grade 350W.

.2 Hollow Steel Sections: CAN/CSA-G40.20/G40.21-M, Grade 350W, Class H.

.3 Fasteners: In areas exposed to public use, bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws and machine bolts hot dipped galvanized to CSA G164. For joining stainless steel components use stainless steel fasteners.

.4 Stainless Steel Plates, Round Bars and Flat Bars: Structural quality with Fy = 50,000 psi.

.5 Stainless Steel Sheet: 18 gauge, AISI type 304 stainless steel with No.4 finish.

.6 Stainless Steel Plates: New stock (not weathered or rusted), to CAN/CSA-G40.21, Grade 300W. Hot-dip galvanize steel plates after fabrication to CAN/CSA-G164.

.7 Galvanized Steel Sheet: Commercial quality, stretcher levelled, 6 mm (0.24") thick to ASTM A446 with minimized spangle zinc coating Z275 to ASTM A526.

.8 Stainless Steel Welding Materials: CAN/CSA-W59. Use electrodes compatible with and of the same properties as the stainless steel.

.9 Isolation Coating: Alkaline and acid resistant bituminous paint.

2.2 ACCEPTABLE SYSTEMS AND MANUFACTURERS

.1 Fall Arrest Wall Anchors: Through bolt mount, Type 304 stainless steel forged eye, with single 19 mm diameter stainless steel bolt, lock washer, nut and 100 mm x 100 mm x 6 mm stainless steel back up plate, FARA-91 by Thaler Metal Products or acceptable equivalents.

.2 Fall Arrest Roof Anchors: Through bolt mount, urethane insulated, all stainless steel post with base plate, flashing sleeve, and Type 304 stainless steel forged eye, FARA-11SS by Thaler Metal Products or acceptable equivalents.

.3 Horizontal Lifelines System: Stainless steel construction, cast stainless steel end and intermediate anchors with shock absorbing sleeves, stainless steel travellers, twin wire stainless steel ropes. Horizontal Lifeline System K-700 Roof Application by Thaler Metal Products or acceptable equivalent.

2.3 FABRICATION

.1 Shop fit and assemble work to greatest extent possible. Disassemble where necessary for field assembly.

.2 Fabricate work with materials, component sizes, metal thickness, reinforcing, anchors, and fasteners to conform to requirements.

.3 Accurately cut, machine, and fit joints, corners, copes and mitres with tightly fitting joints and in true planes.

.4 Fabricate safety and tie-back anchors from structural tubing with stainless steel U bar and accessories. Provide aluminum flashing and insulation fill.

.5 Welding:

.1 Grind welds smooth and polish joints, free of crevices and surface blemishes; provide seamless appearance.

.2 Make welds continuous at joints to prevent water entering assemblies and components.

3 Execution

3.1 EXAMINATION

.1 Examine work of other sections where such work influences the work of this Section and report unsuitable conditions to the Contract Administrator.

.2 Supply anchors, inserts, rough-in dimensions and templates required to be built-in by other Sections, in adequate time.

.3 Have a senior, qualified manufacturer's representative on site to direct and supervise the installation of materials which are installed by other Sections.

.4 Apply isolation coating of approximately 0.76 mm (30 mils) dry film thickness, or other suitable permanent separator on concealed contact surfaces of dissimilar materials, before assembly or installation where there is possibility of corrosive or electrolytic action with concrete, masonry, mortar, or steel.

3.2 INSTALLATION

.1 Install items in accordance with approved shop drawings and manufacturer’s recommendations.

.2 Install work true to line, plumb and level, tightly fitted, securely mounted and flush with adjacent surfaces, as applicable.

.3 Deform threads of tail end of anchor studs after nuts have been tightened to prevent accidental removal or vandalism.

3.3 SITE QUALITY CONTROL

.1 Manufacturer’s Site Services:

.1 Engage manufacturer’s representative to provide field inspection of the installation of their Products.

.2 Monitor and report installation procedures and unacceptable conditions.

.2 Inspections:

.1 Engage a professional structural engineer experienced in design and installation of this work and licensed in the Province where the Project is located, to perform inspections.

.2 Perform timely and regular inspections.

.3 Verify installation conforms to applicable building code and regulatory requirements.

.4 Prepare and submit inspection forms required applicable building code and regulatory requirements.

.3 Field Inspection Documentation: Complete form entitled Initial Inspection – Certification for Use for including in Equipment Manual and Inspection Log Book.

.4 Tests:

.1 Perform pull test on one out four fasteners, in accordance with the requirements of the authorities having jurisdiction.

.2 Test each anchor installed with chemical adhesive fasteners using load cell test apparatus in accordance with manufacturer's recommendations.

.3 Replace fail or defective equipment at no cost to the City.

.4 Prepare and submit reports of test results.

.5 Adjustment:

.1 Adjust operating parts to ensure smooth, efficient operation.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.2 All references standards specified herein imply the latest edition of the standards.

1.2 QUALITY ASSURANCE

.1 Maintenance Seminars: Instruct the City on proper care, cleaning and maintenance procedures.

.2 Source Limitations: Obtain each appliances group product through one source from a single manufacturer.

.3 Energy Ratings: Provide appliances that qualify for the Energy Star product labelling program.

1.3 SUBMITTALS

.1 Product Data: For each type of product indicated. Include operating characteristics, maintenance data, dimensions of individual appliances, and finishes for each appliance.

.2 Appliance Schedule: For appliances; use same designations indicated on Drawings.

1.4 EXTENDED WARRANTY

.1 Manufacturer's standard form in which manufacturer of each appliance specified agrees to repair or replace work or components that fail in materials or workmanship within specified warranty period.

.1 Microwave Oven: Five-year limited warranty for on-site service on defects in the magnetron tube.

.2 Refrigerator/Freezer: Five-year limited warranty for on-site service on the sealed refrigeration system.

.3 Dishwasher: 10-year warranty for in-home service against deterioration of tub and door liner.

2 Products

2.1 MANUFACTURERS

.1 Specified Products: Work of this Section is based on specified products. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator’s acceptance.

2.2 COOKING APPLIANCES GROUP

.1 Microwave Oven: Freestanding, 1.6 cu.ft. capacity, YKMCS122PPS by KitchenAid Canada.

.1 Features: Electronic control panel with LED timer display, and turntable on/off option.

.2 Controls Location: Right side.

.3 Finish: Stainless steel.

.4 t fan capacity].

2.3 BEVERAGE APPLIANCES GROUP

.1 Coffee Maker: Freestanding, 12-cups, KCM1209DG by KitchenAid Canada.

.1 Features: Spiral showerhead, programmable warming plate, removable clear plastic water tanks, and clear glass carafe.

.2 Control Features: Brew timer and clock.

.3 Finish: Charcoal Grey.

2.4 REFRIGERATION APPLIANCES GROUP

.1 Refrigerator: EnergyStar certified, 762 mm (30") wide, freestanding, two doors refrigerator compartment with bottom freezer, 20 cu.ft. capacity, KRFF300ESS by KitchenAid Canada.

.1 Front Panel: Stainless-steel door front panel.

.2 Appliance Finish: Manufacturer's standard finish.

2.5 CLEANING APPLIANCES GROUP

.1 Dishwasher: EnergyStar certified, built-in under the counter, KDFE204KPS by KitchenAid Canada.

.1 Feature: Third level utensil rack, automatic temperature control,

.2 Front Panel: Stainless-steel door front panel with digital control panel.

.3 Appliance Finish: Manufacturer's standard finish.

2.6 FINISHES

.1 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

.2 Factory Finish: Manufacturer's standard finish complying with manufacturer's written instructions for surface preparation including pretreatment and application.

.1 Painted Finish: Baking, color, gloss, and minimum dry film thickness.

.2 Stainless Steel: Ground and polished stainless-steel surfaces for uniform, directionally textured finish.

3 Execution

3.1 EXAMINATION

.1 Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

.2 Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

.1 General: Comply with manufacturer's written instructions.

.2 Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

.3 Utilities: Comply with requirements of Mechanical and Electrical Sections.

3.3 CLEANING AND PROTECTION

.1 Test each item of residential appliances to verify proper operation. Make necessary adjustments.

.2 Verify that accessories required have been furnished and installed.

.3 Remove packing material from residential appliances and leave units in clean condition, ready for operation.

END OF SECTION

1 General

1.1 SCOPE OF WORK

.1 Provide heated high pressure washing system for the Repair Garage area:

.1 One electrically heated, high-pressure hot water washer system,

.2 Complete with rated distribution piping and:

.1 Two (2) wall mounted hose reels with lances in Repair Bay #6 as indicated on the drawings.

.2 Three (3) overhead mounted hose reels with lance in the Repair Bays as indicated on the drawings

.2 Provide cold water high pressure washing system for the Interior Cleaning Bays:

.1 Two (2) cold water high-pressure washer units,

.2 Fixed installation – concrete pad or wall bracket mounted

.3 Wall mounted hose reels

.4 Wands with adjustable nozzle.

.5 Interconnecting piping as shown on the drawings

1.2 QUALITY ASSURANCE

.1 Manufacturer: Provide at least one qualified technician on site for a minimum of two (2) days following Substantial Completion to assist in trouble shooting and adjustment of equipment as needed.

.1 Cost of qualified technician shall be indicated as a Separate Price.

.2 Installer qualifications: For warranty validation, installation shall be performed by qualified factory authorized and trained personnel.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Store products in manufacturer's unopened packaging until ready for installation.

1.4 WARRANTY

.1 High-pressure water washers shall be warranted for a minimum period of two (2) years for parts and labour commencing on Substantial Completion, covering repair and/or replacement of equipment or material that causes any operational disturbances due to manufacturing defects or installation defects occurring within the extended warranty period.

2 Products

2.1 MANUFACTURERS

.1 Acceptable product:

.1 EasyKleen

.2 Pressure Systems Company Inc (PSC)

.3 Hotsy Water Blast Manufacturing LP.

.4 Approved equal.

2.2 PRESSURE WASHERS – ELECTRIC HEATED HOT WATER:

.1 Pump System

.1 Stationary unit

.2 CSA approved

.3 Electric powered and heated

.4 Fully enclosed, including belt guards.

.5 Pump:

.1 Belt-driven industrial duty

.2 Ceramic plunger

.3 Oil bath pump lubrication.

.4 Stainless steel valves

.6 Wash / Rinse operation selection (Repair Bay unit only)

.7 Automatic Start/Stop pump control with solid state time delay shut down

.8 Automatic high temperature system shut down (thermal sensor - pump protection)

.9 Adjustable pressure regulator/unloader with over sized bypass hose

.10 Un-loader Valve:

.1 Pressure-trapping un-loader rated for a minimum of 20.7 MPa (3,000 psig).

.2 Shall operate in conjunction with 2 trigger guns to provide safe operation in starting and stopping water flow through the nozzle.

.11 Pressure Relief Valve:

.1 Located at the discharge port on the coil for over pressurization protection.

.12 High pressure downstream chemical injection. (Repair Bay unit only)

.13 Liquid-filled discharge pressure gauge

.14 Thermal protection (automatic shutdown)

.15 Performance Requirements: Refer to schedules.

.2 Hot Water Heater

.1 Integral to unit frame

.2 Automatic heat exchanger with #316 stainless steel HX coil(s),

.3 Pin-rod type Calrod heating elements with Incoloy sleeves

.4 Adjustable temperature controller

.5 Minimum 200 Litre (55 usg) integrated hot water storage, insulated.

.6 Low level switch with indicator light

.7 Heating Capacity: refer to Schedules

.3 Frame

.1 Welded heavy gauge steel frame.

.4 Coatings

.1 Powder coat painted or approved equivalent

.5 Electrical and Controls:

.1 NEMA 4 / IP66 Enclosures.

.2 Main Power: 575V / 3ph / 60 hz, single point power connection for system.

.3 TEFC motor, minimum 1.25 Service Factor.

.4 Maximum control voltage: 24 Volt

.5 Programmable smart controller, and pre-wired for remote installation.

.6 Local control for wash/rinse at each hose reel location.

.1 Master control from wash bay selector (Bay #6)

.7 Trigger Gun auto Start/Stop when in on position

.8 Pre-programmed auto start stop and auto shutdown to turn off in the event the machine is left on and unattended.

2.3 PIPING:

.1 High pressure piping between the pressure washer and the respective hose reels.

.2 Refer to schedules and drawings.

2.4 WANDS:

.1 Anti fatigue easy-pull trigger gun design

.2 Insulated gun and lance grip

.3 Swivel hose to gun connection.

.4 Stainless steel tubing.

.5 Nozzles:

.1 High pressure nozzles shall be supplied in 0 – 15 – 40 degree spray patterns.

.2 Hardened stainless steel material with 6mm (¼") male quick coupler fittings for ease of use.

.3 Repair Bays: 15 LPM @ 20.7 MPa (4 usgpm @ 3,000 psig) design flow rate each.

.4 Bus Cleaning Lane: 8 LPM @ 10.4 MPa (2 usgpm @ 1,500 psig) design flow rate each.

3 Execution

3.1 INSTALLATION AND TESTING

.1 The complete systems shall meet all applicable code requirements and safety regulations and shall be designed with personnel safety as the prime consideration.

.1 Installer qualifications: Engage an experienced Installer who is an authorized representative or employee of pressure washing equipment manufacturer for both the installation and maintenance of the type of equipment required for this Project.

.2 Manufacturer qualifications: Firm experienced in manufacturing of pressure washing equipment with a minimum of five systems in operation to this Specification and that have a record of successful in-service performance for ten years or greater.

.3 Electrical component standard: Provide components that comply with the CEC , NFPA 70 "National Electrical Code" and are listed and labeled by ULC.

.2 Commissioning

.1 Equipment manufacturer shall provide final testing, acceptance, start-up and commissioning documentation such as water pressure tests, pumps pressure and vibration tests, controls tests, alarms tests, etc., After completion of the work as described above, the manufacturer shall provide a certificate of commissioning.

.3 Training

.1 Equipment manufacturer shall provide minimum 2 hrs of training for operators and provide training certificates upon training completion.

.2 Equipment manufacturer shall provide a program of preventive maintenance and provide minimum 4 hrs training for maintenance personnel, and provide training certificates upon training completion.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Provide manually operated roller shades (RWS) includes extruded aluminum shade fasci, accessories and brackets.

1.3 REFERENCE STANDARDS

.1 US Green Building Council (USGBC):

.1 Reference guide for Building Design and Construction

.2 LEED v4 Project Scorecard

1.4 SUBMITTALS

.1 Product Data: Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.

.3 Mounting details and installation methods.

.2 Shop Drawings: Show shade arrangements, layout, plans, elevations, sections, product details, installation details, operational clearances, and relationship to adjacent work.

.3 Samples: For each finish product specified:

.1 One complete set of shade components, unassembled, demonstrating compliance with specified requirements, shows material finishes and colours as specified.

.2 Shade Cloth Samples: Duplicate 300 mm x 300 mm (12" x 12") sample of each type of shade fabric.

.4 Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

.5 Warranty: Provide manufacturer's warranty documents as specified in this Section.

1.5 SUSTAINABLE DESIGN SUBMITTALS

.1 Submit copy of LEED submittals, unless otherwise indicated.

.1 LEED v4 Materials Reporting Form - BPDO

.2 LEED v4 Materials Reporting Form – Low Emitting

1.6 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section. This includes but is not limited to all required extrusions, accessories, controls and fabricated roller shades or else all stated and published warranties may be void.

.2 Installer Qualifications: Engage an installer, which shall assume responsibility for installation of all system components, with the following qualifications.

.1 Installer for roller shade system shall be trained and certified by the manufacturer with a minimum of ten (10) years' experience in installing products comparable to those specified in this section.

.3 Shadecloth Anti-Microbial Characteristics: 'No Growth' per ASTM G21 results for fungi ATCC9642, ATCC 9644, and ATCC9645.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver components in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.8 PROJECT CONDITIONS

.1 Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.9 WARRANTY

.1 Warranty: Provide manufacturer's standard warranties, including the following:

.1 Roller Shade Hardware, and Shadecloth: Manufacturer's standard non-depreciating twenty-five (25) year limited warranty.

.2 Roller Shade Installation: One (1) year from date of Substantial Completion.

2 Products

2.1 MANUFACTURERS

.1 Specified Products: Work of this Section is based on product Mecho/7 by MechoShade Systems Inc.

.2 Products by the following manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

.1 Hunter Douglas Architectural Window Coverings.

.2 Legrand Shading Systems

2.2 MANUAL ROLLER SHADES

.1 Operation; Manual chain and roller operated system, incorporating an adjustable slip clutch to control rate of fall.

.2 Chain: Continuous loop of stainless steel beads, capable of resisting 45 kg (100 lb.) pull.

.3 Bracket Operating Assembly: 3 mm (1/8") steel bracket and injection moulded delrin components assembled on 11 mm (7/16") diameter welded steel shaft. Provide Wall, jamb or ceiling mounting and centre brackets as required. Reversible for left hand or right hand operation.

.4 Clutch/ Brake Operation: Urethane dampened clutch to protect chain and clutch to fail from high shock loads during shade operation. Provide brake to withstand minimum pull force of 22.7 kg (50 lbs) at stopped position.

.5 Shade Roller: Extruded 6063 T6 aluminum tube, sized to suit operating system with asymmetrically shaped mounting channels to which a matching snap in vinyl spline can be mounted.

.6 Shade Spline: Extruded vinyl with asymmetrical insertion locking channels and embossed shade guide.

.7 Tube and plug and pin assembly shall be tapered to assure alignment and shade edge protection.

.8 Fascia: 1.6 mm (0.060") extruded aluminium, designed to snap on to shade mounting bracket assembly with concealed fastening devices. Provide removable fascia filler to bridge window mullions where indicated.

.9 Blackout Channels: Extruded aluminium channels complete with black out seals.

2.3 SHADECLOTH

.1 Sun Control Fabric: Heat seal, non-ravelling, 0.9 mm single thickness, PVC free thermoplastic olefin fabric woven; 3% open bi-directional. Refer to 09 06 00 Finish Schedule for colours requirements.

2.4 FINISHES

.1 Finish exposed to view aluminium and steel components in baked-on enamel, white colour.

3 Execution

3.1 EXAMINATION

.1 Do not begin installation until substrates have been properly prepared. If substrate preparation is the responsibility of another installer, notify Contract Administrator of unsatisfactory preparation before proceeding.

3.2 PREPARATION

.1 Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

.1 Securely install work, accurately aligned and free of sag.

.2 Coordinate installation and fastenings with window and ceiling trades, and trades providing adjacent finishes.

.3 Provide, as part of work of this Section, custom trim components including gypsum board and tee bar trim items to accommodate adjacent ceiling systems and finishes to approval of the City.

.4 Install shades in accordance with manufacturer's instructions and as indicated, in true, flat planes.

3.4 ADJUSTMENT AND CLEANING

.1 Adjust shades for smooth operation and correct alignment. Clean shades and remove finger marks and smudges from shades and adjacent surfaces. Leave shades in raised position at completion of work of this Section.

.2 Clean and make good surfaces soiled or otherwise damaged in connection with work of this Section. Pay cost of replacing finishes or components that cannot be satisfactorily cleaned.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section

1.2 SUMMARY

.1 This section includes labour, materials and other services to complete the fabrication and installation of:

.1 Recessed entry foot grilles, including all materials and fitments required for the operation of unit furnished as indicated in drawings and specified herein.

1.3 REFERENCES

.1 Canadian Standards Association (CSA):

.1 CSA W59.2, Welded Aluminum Construction

.2 American Society for Testing and Materials (ASTM):

.1 ASTM B221, Standard Specification for Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

1.4 QUALITY ASSURANCE

.1 Structural Performance: Capable of withstanding and supporting a uniform load of 14.36 kN/sq.m. (300 lbf/sq.ft.) without exceeding the allowable design working stress of the materials involved, including anchors and connections.

.2 Maintenance Seminars: Engage a factory authorized service representative to train the City's maintenance personnel on proper procedures and schedules for adjusting, operating, troubleshooting, servicing, and maintaining the work.

.3 Pre-Installation Meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.4 Installer: Have work of this Section execute by installer with a minimum five (5) years continuous Canadian experience in successful manufacture and installation of work of type and quality shown and specified. Submit proof of experience upon Contract Administrator's request.

.5 Source Limitations: Obtain each type of product from a single manufacturer.

.6 Products: Provide like Products from same production run.

1.5 SUBMITTALS

.1 Submit product data for floor grid and frame to be supplied, including manufacturer's specifications and installation instructions, details of construction relative to materials, dimensions of individual components, profiles, anchors and accessories.

.2 Shop Drawings:

.1 Submit shop drawings showing and describing in detail, materials, finishes, dimensions, details of connections and fastenings, plans, sections, metal gauges, hardware and any other pertinent information.

.2 Make thorough examination of drawings and details, determine the intent, extent, materials, conditions of interfacing with other work and be fully cognizant of requirements.

.3 Submit 305 mm x 305 mm (12" x 12") samples of foot grilles system, including minimum 305mm (12") long of support frames, sample to show the foot grille at corner condition. .

.4 Maintenance Data: For cleaning and maintaining foot grilles. Include in maintenance manuals.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store materials in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

.4 Unsatisfactory materials shall be removed from the site.

.5 Adequately protect the structure and work of other Sections during delivery, storage, handling and execution of the work of this Section.

.6 Provide tools, plant and other equipment required for the proper execution of the work of this Section.

1.7 WARRANTY

.1 Warrant work of this Section against defects in materials and workmanship in accordance with the General Requirements for a period of five (5) years and agree to promptly make good defects which become evident during warranty period without cost to the City.

2 Products

2.1 MATERIALS

.1 Aluminum:

.1 Extrusions and Shapes: ASTM B221/B221M, alloy 6061-T6 or alloy 6063-T5, T6, or T52 as standard with manufacturer, mill finish.

.2 Exposed surfaces of aluminum shall be free of die marks, scratches, blisters, "leave-off" marks, or other blemishes, whether left unfinished or finished.

.3 Aluminum Welding Materials: Conforms to CSA W59.2.

.2 Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 304, mill finish.

.3 Screws, Bolts, Nuts, Washers, Rivets and other Fastening Devices: Stainless steel with not less than 12% chromium content to prevent galvanic action, and of sufficient strength for the purpose.

.4 Bituminous Paint: Acid and alkali resistant bituminous isolation coating.

2.2 FOOT GRILLES

.1 Specified Products: Design of the work of this Section is based on the products specified. Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator’s acceptance.

.2 General: Manufacturer's standard foot grille assemblies consisting of treads of type and profile indicated, joined together by cross members or interlocked, and with required support legs and other components required to produce a complete hinged, lockable and watertight installation.

.1 Buff work to remove scratches, welding, or grinding produced in fabrication process.

.3 Aluminium Foot Grilles: Extruded aluminium I beam tread rails with serrated surface, clear anodized finish.

.1 Acceptable Products:

.1 25 mm x 38 mm, FG-5 by K.N. Crowder.

.2 35 mm x 38 mm, BLA-1 by Bolar.

.3 36 mm x 38 mm, Pedigrid SA G8 by Construction Specialties.

.4 Grid Frames: 6063-T5 aluminum alloy with minimum 13 mm (1/2”) exposed trim, 40 mm (1-1/2") deep recess try. (46.0mm). Provide full length of vinyl gasket at the base of grille tread rail at every 510 mm (20”). Frame finish same as grille tread rails.

.5 Drain Pan: Manufacturer's standard 1.3 mm (16 gauge) aluminium sheet pan, equip with stainless-steel strainer and PVC drain connector.

.1 Coordinate installation work with Mechanical drawings and specifications. Make drain pans watertight.

.6 Wall Base Accessories:

.1 Metal Wall Base (MWB): 110 mm high stainless steel wall base strips with cove end and seal clip, includes connector and corner profiles to suit installation requirement:

.1 Basis-of-Design Materials: DesignBase-SL-E by Schlüter.

2.3 FOOT GRILLES SCHEDULES

.1 FGR-1: Aluminium foot grilles with frames and drain pan.

.2 FGR-2: Aluminium foot grilles with frames.

3 Execution

3.1 EXAMINATION

.1 Inspect surfaces over which the work of this Section is dependent for any irregularities detrimental to the application and performance of the work of this Section.

.2 Notify Contract Administrator in writing of all conditions which are at variance with those in the contract documents and/or detrimental to the proper and timely installation of the work of this Section.

.3 The decision regarding corrective measures shall be obtained from the Contract Administrator prior to proceeding with the affected work.

.4 Commencement of work implies acceptance of surfaces and conditions.

3.2 PREPARATION

.1 Co-ordinate the work of this Section with the work of other Sections to provide the necessary recesses, edge conditions for the accessories as required.

.2 Set frame above floor slab to suit the adjacent floor finish height, ensuring a level transition from floor finish to foot grille and back to floor finish.

.3 Upon completion of installation of entrance mat frames, provide temporary plywood filler protection in entrance mat recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended.

3.3 INSTALLATION

.1 Install work in accordance with manufacturer's instructions, with top of foot grilles and frames flush to one another and to adjoining finished flooring.

.2 Set foot grille tops at height for most effective cleaning action.

.3 Coordinate top of foot grille surfaces with doors that swing across grilles to provide clearance under door.

.4 Provide grille unit complete with drain pan sloped to drain and with anchors at 600 mm o.c. for anchoring into concrete.

.5 Coat all surfaces of aluminium and stainless steel in contact with concrete and dissimilar metals with protective coating recommended by manufacturer.

.6 Locate, align and level frames in floor recess with top flush with adjacent finished floor.

.7 Maintain uniform gap between grilles and frame, at maximum 3 mm.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section

1.2 SUMMARY

.1 This section including fabrication and erection, by manufacturer or his authorized fabricator/erector of the workstation system and furniture as listed in the Workstation System and Furniture Schedule and in the Contract Drawings.

1.3 REFERENCES

.1 City of Winnipeg, Furniture and Space Standards

1.4 DEFINITIONS

.1 Workstations: Complete and usable system of workspace composed of panels, stacking panel-frames, spine walls, covers, work surfaces, storage units, supporting components, electrical hardware, communications, and accessories.

.2 Covers: Synonymous with panel, wall and frame factory finished covers, tiles and skins as applicable furniture system used.

1.5 SYSTEM DESCRIPTION

.1 Panel System: Unitized interconnecting panels capable of accommodating factory finished exposed trims and removable wall covers, power and communication management, and structurally supporting more than one fully loaded component per panel per side of work surfaces, shelves, files, and other components in the configurations indicated.

.2 Spine Wall System: Site connected framed substructure, capable of accommodating factory finished exposed trims and removable wall covers, power and communication management, and structurally supporting more than one fully loaded component per side of work surfaces, shelves, files, and other components indicated, as well as allow various off module attachment locations horizontally for these components.

.3 Desk Based System: Free-standing and independent of panel system support, capable of structurally supporting work surfaces, shelves, and other components indicated.

1.6 DESIGN AND PERFROMANCE REQUIREMENTS

.1 Panel Acoustics: Minimum NRC of 0.80 when tested to ASTM C423 and minimum STC of 24 when tested to ASTM E90 on the entire assembled panel, full face area.

.2 Fire Performance Characteristics: Maximum flame spread of 25 when tested to ULC S-102.

.3 Power and Data Management: Easily accessible by wall covers which can be removed while workstation components are still attached.

.4 Raceway and Outlet Locations: Panel base, mid-panel or panel top.

1.7 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Having a minimum 15 years experience in the design, fabrication of work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type.

.1 If requested, submit names of projects with locations, names of the City and Contract Administrator where the Product to be used has been used previously and performed satisfactorily, date it was installed, and size of installation.

.2 Installer: Trained and approved by the manufacturer and having a minimum three years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.

.1 Qualifications include having the necessary experience, staff, and training to install manufacturer's products. Manufacturer's willingness to sell its products to installers does not in itself confer qualification on installer.

.3 Maintenance Seminars: Engage a factory authorized service representative to instruct the City on proper care, cleaning and maintenance procedures.

.4 Source Limitations: Obtain each type of product from a single manufacturer.

.5 Products: Provide like Products from same production run.

.6 Pre-Installation Meetings: Two weeks prior to commencing Work of this Section, arrange for each respective manufacturer's technical representative to review with the Contractor and Contract Administrator procedures to be adopted, conditions under which the Work will be done, and inspect the surfaces to receive the Product, in order that any alternate recommendations may be made should adverse conditions exist.

.1 Review construction schedule and verify availability of materials, installer's personnel, equipment, and facilities necessary to make progress and avoid delays.

.7 Electrical Components, Devices, and Accessories: CSA certified and labelled.

1.8 SUBMITTALS

.1 Product Data: Manufacturer's product and construction specifications which provide technical data for furniture system and components specified.

.1 Lighting: Include task lighting and illumination performance information.

.2 Workstations: Complete listing of part/model numbers for all components to be furnished, including names and codes of components referenced on shop drawings.

.3 Furniture: Complete listing of model names and numbers for the item, including material, colour, texture, and dimensions.

.2 Samples: Four sets of finish samples listed below from manufacturer’s standard colour chart for selection by the Contract Administrator.

.1 Panel Tackboard and Fabric: Minimum 150 mm x 150 mm (6” x 6”) with label designating the manufacturer, color, fiber content, fabric weight, fire performance characteristic, and use.

.2 Panel, and Spine Wall, Work Surface and Component Finish: Minimum 75 mm x 75 mm (3” x 3”) with label designating the manufacturer, material composition, thickness, color, and finish.

.3 Task Lights: Full size ballast and lamps.

.4 Glazing. Minimum 150 mm x 150 mm (6” x 6”) samples with label designating the material and safety ratings.

.3 Certificates: Two complete sets of certificates attesting that the installed workstation meets specified requirements, and listing name the project, and specific requirements being certified.

.4 Operation and Maintenance Data: Three sets of manuals describing assembly and reconfiguration procedures, and proper cleaning and minor repair procedures.

.1 Electrical System: Three sets of electrical system manuals describing functions, configuration, and maintenance of the system power, communications, data systems.

.5 Shop Drawings: Two complete sets of shop drawings. Include:

.1 Installation Drawings: Show workstations, panels, spine walls, components, and plan view within each floor, identified by workstation type.

.2 Workstation Elevations: Show dimensioned elevations of each type of workstation panels and components identified with manufacturer's catalogue numbers.

.3 Panel and Spine Wall Drawings: Show locations and critical dimensions from finished face of walls, columns, panels, including clearances and aisle widths. Key assemblies to a legend showing width, height, configuration and composition of cover finishes and fabrics, power or non-power, connectors and systems furniture mounted hardware.

.4 Electrical Drawings: Show power provisions including type and location of feeder components, service entry poles, base or ceiling feeds, activated outlets and other electrical components. Identify and provide wiring circuiting, switching, internal and external connections. Include legend.

.1 Wire management capacity drawings.

.2 Voice Communication Drawings: Indicate type and location of feeder components and outlets with wiring configuration.

.3 Data Communication Drawings: Indicate type and location of feeder components, outlets, or accessories with wiring configuration.

.4 Local Area Network Communication Drawings: Indicate type and location of feeder components and data outlets with extra ports for future expansion with wiring configuration.

.6 Electronic Record Drawings: Submit drawings for future re-configuration in the software package required by the City. Incorporate requirements of reviewed shop drawings and reflecting as-built conditions.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Deliver components in manufacturer's original packaging with the brand, item identification, and project reference clearly marked.

.2 Remove components from packaging and store in ventilated, unoccupied, and dry location, free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

1.10 ALTERNATIVE DESIGN

.1 Manufacturers unable to provide work that conform exactly to the furniture, workstation types and layouts indicated may submit alternative designs for consideration by the Contract Administrator. Alternative designs must meet or exceed the following criteria.

.1 Size and Configuration: Compliance to the same basic size and configuration indicated, with only the sizes of the individual components within the changed to meet the standard product of the manufacturer.

.2 Component Requirements: Maintain types of components or elements indicated.

.3 Layout: No reduction in the storage capacity, number of workstations and furniture accommodated, width of aisles, location of furniture or workstation configuration.

.4 Power Cabling: Compliance to configuration indicated with only variation in size or quantity that exceeds the specified configuration. Maintain circuiting and connection capabilities indicated.

1.11 WARRANTY

.1 Provide manufacturer's ten year material and workmanship warranty, commencing from date of Substantial Performance, covering the replacement or making good of defects and deficiencies in materials and workmanship. Exceptions:

.1 Fabrics and Other Covering Materials: Three years.

.2 Task Lights: Two years.

2 Products

2.1 MANUFACTURERS

.1 Specified Products: Work of this Section is based on the products listed in the schedule. Products by manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

.2 Acceptable Product Suppliers:

.1 Teknion

.2 Global

.3 Steelcase

.4 Haworth

2.2 MATERIALS

.1 Sheet Steel: Cold rolled steel, ASTM A653/A653M Grade A, Z275 Commercial Quality zinc coating, factory finished in powder coating applied after fabrication.

.2 Particleboard: ANSI A208.1, 720 kg/cu.m. (45 lb/cu.ft.) density, mat formed wood particleboard.

.3 Medium Density Fibreboard (MDF): ANSI A208.2, density 769 kg/cu.m. (48 lb/cu.ft).

.4 Plastic Laminate: NEMA LD-3, high pressure paper base decorative laminates.

.1 Facing Sheet: Grade HGS, 1.2 mm (0.048") thick.

.2 Backing Sheet: Grade BK, same thickness as facing sheets, sanded one face and manufactured by the same manufacturer as the facing sheet.

.5 Melamine Board: Melamine resin impregnated low pressure laminates, thermally fused to particleboard or MDF core. Standard colour.

.6 Fabric: 100% polyester fabric, moisture and mildew resistant, flame retardant treated.

.7 Powder Coating Finish: Polyester based, thermosetting, electrostatic coating. Provide coating system that complies with coating manufacturer's written instructions for pre-treatment, application, baking, and minimum dry film thickness. Standard colour.

.8 Raceways and Covers: Integral part of panel and spine wall, whether powered or non-powered.

.9 Levelling Glides: Minimum 19 mm (3/4") adjustment range and capable to provide precise alignment of adjacent panels and spine walls.

.1 Panel-to-Panel Systems: Two levelling glides, each panel.

.2 Panel-to-Post Systems: One levelling glide, each connecting post.

.3 Stacking Panel Systems: Two levelling glides, each vertical panel assembly.

.10 Panel and Spine Wall Connecting Posts: Capable to accommodate a variety of configurations such as straight line, corner, T connection, cross connection of 4 panels, and a connection of 2

panels for setting the panels at any angle, with continuous visual and acoustical seals, in height matching panel of spine wall top rail.

.1 Finish: Matching system components. Provide trim pieces to finish exposed edges when used in connecting panels of dissimilar heights.

.2 Panel and Spine Wall Removal: Allow removal of a single panel or spine wall within a typical workstation configuration without requiring disassembly of the workstation or removal of adjacent panels or spine walls.

.3 Right Angle Connections: No interference with the capability to hang work surfaces and other components on any adjacent panel.

.4 Power and Communication Wiring: Continuous wiring within workstations and from workstation to workstation.

.11 Tackboards: Manufacturer's standard with glass fibre core and fabric finish.

.12 Miscellaneous Hardware: Brackets, supports, hangers, clips, panel supported legs, connectors, adjustable feet, cover plates, stabilizers, and other miscellaneous hardware required for a complete installation.

.13 Office Furniture: As indicated in the Furniture Schedule in Contract Drawings.

.1 Manufacturer's catalogue numbers specified, denote quality, style and function of items required. All furniture and accessories shall be as specified or approved equal.

.2 Treat upholstered furniture with Scotch-Gard protective spray, apply spray in accordance with manufacturer's instructions.

.1 Protective Spray: manufactured by 3M.

2.3 FABRICATION - GENERAL

.1 Design and fabricate work to allow for expansion and contraction of the materials.

.2 As far as practical, shop assemble work for delivery to site ready for installation and in size easily handled and to ensure passage through building openings.

.3 Fabricate work square and to the required lines. Recess and conceal fasteners and anchor heads.

.4 Make each unit rigid and self supporting, suitable for individual removal.

.5 Fabricate workstation products free of rough or sharp edges, make exposed edges and curves smooth.

.1 Panel and Spine Wall System Components: Having positive, integral locking devices which secure components without the use of additional screws or clamps to prevent the components from being accidentally pulled or knocked off the panels.

.2 Desk Based Workstation: Having the option for positive, integral locking devices that secure components to the base units.

.6 Exposed Metal Components and Trims: Factory finished after fabrication in powder coating finish.

.7 Panel and Wall Fabric Covers: Manufacturer's standard construction, tackable where indicated, factory finished with one piece seamless fabric stretched and securely attached continuously along perimeter of covers. Make provision for site replacement of fabric.

2.4 FABRICATION - WORK SURFACES

.1 Fully support work surfaces either fully supported from the panels or spine wall with metal brackets or supported jointly by the panels or spine wall and supplemental legs, pedestals, or end

panels. Use supplemental end panels only under work surfaces when the workstation configuration does not permit full support by the panels or spine wall.

.1 Construction: Construct work surfaces to prevent warpage. Use balanced finish for top and bottom surfaces.

.2 Height Adjustment: Adjustable in 25 mm to 40 mm (1" to 1-1/2") increments from 630 mm to 1040 mm (25" to 41") above finished floor. Provide continuous and level surface at abutting work surfaces of same height in side-by-side arrangement.

.3 Panel Support Metal Brackets: Provide metal-to-metal fitting to the vertical uprights of the panels or spine wall, vertically adjustable, and lock work surfaces in place without panel or spine wall modifications.

.4 Finishes: Top surface in high pressure plastic laminate, smooth underside and vinyl moulding edges, and capable of being cleaned with ordinary household cleaning solutions and resistant to ordinary household solvents, acids, alcohols, or salt solutions. Finish support brackets matching color and finish of trim.

2.5 FABRICATION - DRAWER AND CABINET PEDESTALS

.1 Free standing with castors and base support for work surface types, field interchangeable.

.2 Drawer Construction: To stay securely closed when in the closed position and fully extended in the open position with a safety catch to prevent accidental removal when fully open. Provide manufacturer's standard pulls.

.1 File Drawers: Capable of hanging letter size files front to back or side to side, or legal size files from side to side, complete with hanging folder frames, compressor dividers or rails.

.3 Cabinets Construction: Shelf units, depth to accommodate a standard three ring binder, doors to remain securely fastened when in the locked position.

2.6 LOCKS AND KEYING

.1 Cylinders and Keys: Field changeable, with minimum of 100 different key biting. Consult with the City for keying requirements. Stamp cylinders and corresponding keys with keying codes. Provide:

.1 Two keys for each lock or 2 keys per workstation when keyed alike.

.2 Three master keys.

.2 Keying: Key each workstation individually. Key locks within a workstation alike.

2.7 ELECTRICAL

.1 Powered panels and spine walls: Provide raceways capable of distributing power, communication, data wires and cables using acceptable cable assemblies, wiring harness or electrified bus with 20 amp 90 degree C, #12 AWG wires (unless indicated otherwise) conductors.

.2 Non-Powered Panels: Capable of easy field conversion to powered panels without requiring the panel spine wall to be dismantled or removed from workstation.

.3 Panel Raceways: Flush mounted, hinged or removable metal or plastic covers in colour matching panel trim. Do not extend raceway past frame cover by more than 13 mm (1/2").

.1 Raceways: Minimum of 2 knockouts per side for power connections or outlets.

.4 Spine Wall: Capable to support lay-in cabling and have a large capacity for power and data.

.1 Provide ample space in the interior of the spine wall frame for storing excess wires and fiber optic cables. Provide easy access to power and data systems without having to move return panels or components.

.2 Capable to provide power to a wall-attached panel system and/or an adjacent desk system.

.3 Provide hinged or removable covers that permit easy access to the raceway when required. Secure mount covers so that they cannot be accidentally dislodged under normal conditions.

.4 Keep raceway in the wall or panel base to less than 13 mm (1/2") beyond the spine wall or panel face. Keep other raceways flush with the wall face.

.5 Metal or plastic raceways covers matching finish and color of the panel trim, unless otherwise stated.

.5 Power Distribution: 8-wire configuration in internal raceway and the capability of disconnecting and connecting external circuits to workstation raceway.

.1 Conductor Allocation of Three-Phase 8-Wire System:

.1 One equipment ground.

.2 One isolated ground.

.3 One neutral per phase.

.4 One each dedicated phase.

.6 Receptacles: Commercial grade, complying with CSA C22 and Electrical Sections.

.1 General Use Receptacles: Duplex.

.2 Special Use Receptacles: Simplex with blade/pin arrangement identified on the plans.

.3 Receptacle Body Colours: Coordinated with the color of the panel and spine wall finish trim, except isolated ground receptacles colour to CSA C22 requirements.

.4 Field Applied Identification: Permanent type, do not use stick-on or non-setting adhesives.

.5 Receptacle Removal Tools: Minimum of five receptacle removal tools for systems that require special tools for proper receptacle removal.

.7 Power Connections

.1 Workstation Internal Connections: Hardwired connections.

.2 External Connections to Building Services: Direct-wired entry modules with wiring from building services to entry modules in metal conduit or tubing or in flexible liquid-tight conduit 1830 mm (6') maximum. Do not use cord and plug assemblies.

.8 Wire Management: Provide wire management capacity to accommodate all cable types including the applicable manufacturer required bending radius at corners. Exposed or loose wiring will not be acceptable.

.1 Raceways and Interfaces: Purpose designed and made, to accommodate Category 5 and fiber optic cables communication wiring, covered wire management troughs in vertical end panels, horizontal wiring troughs, internal mid-panel raceways, or rear gaps between the back edge of the work surface and the facing support panel.

.2 Grommet Kits: Manufacturer's standard.

.3 Horizontal Wire Managers: Prefinished, securely attached under-counter mounting or to the vertical panel without damaging the face, to conceal and accommodate outlet cords as well as electrical and communications wiring.

.4 Power and Communications Wiring Separation: Use separate raceways or by placement of channels in joint-use troughs or wireways.

.9 Circuit Layout: Connect devices to the designated circuits in the neutral and ground configurations indicated. Make connections to building service system as indicated and in accordance with applicable Electrical Sections.

.10 Special Systems: Raceway systems for secure and non-secure power, computer and telecommunications cabling. Separate secure distribution from non-secure distribution by running secure lines along top located raceway and non-secure along the bottom of the workstation panel and spine wall.

3 Execution

3.1 INSTALLATION – WORKSTATION SYSTEM

.1 Install work in accordance with manufacturer's recommended installation instructions.

.2 Install work level, plumb, square, and in proper alignment with adjoining furniture. Securely interconnect components and attach to the building where required.

.3 Furnish three sets of special tools and equipment necessary for the relocation of panels and other components.

3.2 INSTALLATION - FURNITURE

.1 Installation of all furniture and accessories specified in this Section shall be in accordance with the drawings and the manufacturer’s printed instructions.

.2 Install furniture and accessories in locations indicated and as directed by the City.

.3 Install build in furniture work level, plumb, square, and in proper alignment with adjoining furniture. Securely interconnect components and attach to the building where required.

3.3 CLEANING

.1 Adjust operating hardware for smooth and proper operation.

.2 Wipe down surfaces to remove fingerprints and markings and leave in clean condition.

.3 Upon completion of installation, clean and polish work.

.4 Repair defects in material and installation. Replace work that cannot be satisfactorily repaired.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 RELATED DOCUMENTS

.1 Schedule of workstation systems and furniture applies to location as indicated in the Contract Drawings.

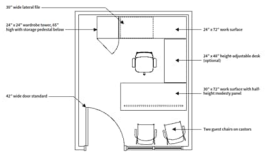
.2 Schedule includes Basis of Design finish and product selections.

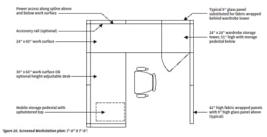
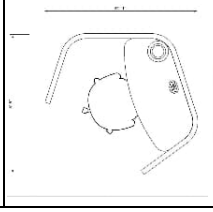
.1 Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to Contract Administrator's acceptance.

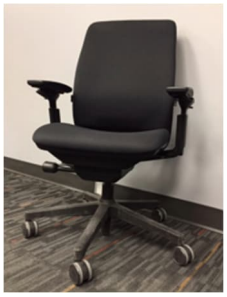
.3 Refer to floor plans, furniture plans, legends and Drawings for location of applied the workstation system and furniture as listed in the schedule of this section.

.4 Refer to technical specifications for submittal, quality and installation requirements for each product and finish listed in this schedule of finish.

1.3 WORKSTATION SYSTEM AND FURNITURE SCHEDULE

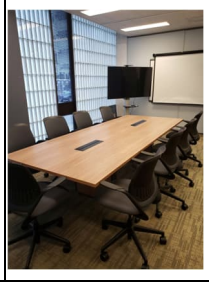
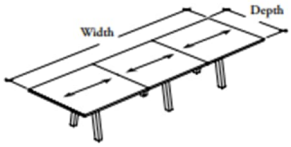
Code	Standard Design Requirement	Product Selection
WS-1	**Private Office Workstation** • Front Desk with Modesty, Open Legs or Side Gable 30 " x 72" • Side Height Adjustable Table 24" x 48" • One lateral file at the back • Work surface 24"x72" • Wardrobe tower at the end 24" X 24" X 65" 	**Teknion Expansion Casegoods** • BMMDWO Table Desk • BASML 10" H Modesty Panel • BHKHW Workwall Kneespace Module – for HA Surface • BHMWBK HA Rectangular Worksurface - Mid-Height • BMZUL Credenza w/ Single Lateral File • BFDSS 24" D x 18" W tower with BFF • Plam: Coastal Elm, Metal Paint: Soft Gris 

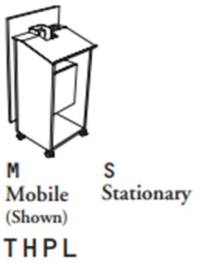
Code	Standard Design Requirement	Product Selection
WS-2	**Open Office** • High fabric wrapped panels 7'x9' overall, overall H=51”, 42” panel fabric wrapped with 9" high glass • Panel above and power access along spline above and below work surface • 30"x60" work surface • Mobile storage pedestal w/ upholstered top • Worksurface24"x60" • Wardrobe tower at the end 24"x2  	**Teknion Expansion Desking** • To match standard requirements • RBSCL half wardrobe unit with drawers • RMSRL spine desk - SGL sided freestanding • RTLDL rectangular worksurface • RAVGL semi-supported leg • RBTPS mobile ped • RPSBG 1" laminate floor screen, back connection • RPSLG 1" laminate floor screen, lateral connection • Floor Screens 51” high fabric wrapped panels (42”+9”glass panels) • Plam: Coastal Elm, Metal Paint: Soft Gris; Panel: Acutate-4073/ Facet 4073 - 04 
WS-3	**PC Station** • Standard not provided	**Teknion Zones** • Solo Focus Enclosure • ZNCFS55 L/R + ZNWWFSTYL worksurface (Chair CH-2b as specified herein) • Wing Panels H55”, Flat Screen assemblies18”, Curved Screen assembly25-3/4”, Curved End Screen assemblies 43-3/4” • Plam Screen: Coastal Elm, Plam Worksurface: Metal Paint: Soft Gris  

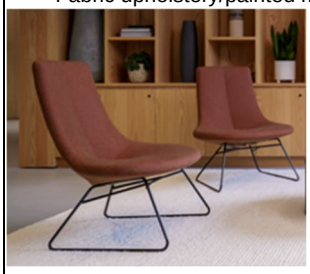
Code	Standard Design Requirement	Product Selection
CH-1	**Task Chair** Single shift use single shift task chairs are those used by a single user during a standard 8hr business day. Features must include: • minimum 19-20” wide seat with padded “waterfall style” front edge and adjustable seat pan • Height adjustable seat (minimum range 17-21”) • Depth adjustable seat (minimum range 16-20”) • Adjustable lumbar support (10-19” wide) at minimum, height adjustable back preferred • Minimum recline of 15 degrees • 4-way adjustable arms • Steel base with casters appropriate to the flooring type • Weight capacity of 350lbs minimum task chair 	**Teknion SAVER chair** • To match standard requirements • Hard silicone casters for carpet flooring • Upholstery back and seat in Dark Gray • Mesh in Black • Frame in Black • Weight capacity of 350lbs minimum task chair  
CH-2A	**Guest Chair (for carpet flooring)** • Guest chairs are intended for Private Offices for short meetings. They • must accommodate a diversity of guests for quick conversations and • will be available in either upholstered or mesh back with two colour • selections for each, and a black frame. Features include: • four-leg or 5-star base with caters loop arms • weight capacity of 300lbs minimum 	**Teknion Amicus Guest Chair** • To match standards • Arms, seating in gray & back in black upholstery or mesh • Hard casters (for carpet flooring) • Frame in Mica silver • Weight capacity of 300lbs minimum 

Code	Standard Design Requirement	Product Selection
CH-2B	**Guest Chair (for hard flooring)** Guest chairs are intended for Private Offices for short meetings. They must accommodate a diversity of guests for quick conversations and will be available in either upholstered or mesh back with two colour selections for each, and a black frame. Features include: • four-leg or 5-star base with caters loop arms • weight capacity of 300lbs minimum 	**Teknion Amicus Guest Chair** • To match standards • Arms, seating in gray & back in black upholstery or mesh • Soft casters (for concrete flooring) • Frame in Mica silver • Weight capacity of 300lbs minimum 
CH-3	**Training/Conference Chair** Conference chairs in meeting rooms are not as frequently used as task chairs, but must accommodate a wide diversity of users, sometimes for several hours at a time. Conference chairs will be available in a choice of two upholstery colours with a black frame. Features will include: • adjustable seat height • 5-star base with casters • fixed arms • mesh back preferred for breathability • weight capacity of 350lbs minimum 	**Teknion Variable Conference Chair** • To match standards • Fixed arms • Seat fabric upholstery in dark gray • Back rest in mesh finish in black • Frame in Black • Hard casters (for carpet flooring) • Weight capacity of 350lbs minimum 
CH-4	**Break Room Chair** Standard not provided	**Teknion Nami side Chair** • Side Chair NNAC CN • Seat Finish in Wood Veneer shell in Natural Maple • Sled support Chrome Finish with floor pads • With Stacking bumpers 

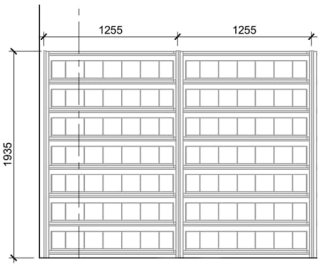
Code	Standard Design Requirement	Product Selection
CH-5	**Bar Stool** Standard not provided	**Teknion Nami side Chair** • Counter ht NNAS CN • Seat Finish in Wood Veneer in Natural Maple • Shell Chrome Finish with floor pads • Sled support with floor pads 
TT-1	**Training Table** The tables must be able to be ganged together in different configurations according to the function. Specifications will include: • high pressure laminate top with pvc edging and powder coated metal legs to defend against premature wear and tear • flip top and nesting capable for ease of reconfiguration and storage • legs to have lockable casters • modesty panel	**Teknion Learning Tables** • To match standards • Kupp Flip-top table XTFTKM • D30" x W60" • Modesty Panel • Foldable • Stackable • Nesting hardware • Hook under the work surface • Each table has mounted power module/PM-1(see below in the schedule) • Plastic Laminate finish, painted metal frame, modesty panel fabric 
TB-1	**Coffee Table** Standard not provided	**Teknion Routed Coffee Table** • Routes CQTCR2442 • H14”, W42”, D 24” Plastic Laminate finish, painted metal frame 

Code	Standard Design Requirement	Product Selection
TB-2A	**Break Room Table** Standard not provided	**Teknion Banqs Tables Flat Base** • Break room table w/ 4 prong base • H29" W30" D30” • Plastic Laminate finish, painted metal frame 
TB-2B	**Break Room Table** Standard not provided	**Teknion Banqs Tables Flat Base** • Break room table w/ 4 prong base • H30" W48" D30” • Plastic Laminate finish, painted metal frame
TB-3	**Conference Table** Conference tables for small and medium meeting rooms should be sized according to the size of the space. They should be constructed of laminate with high pressure tops and low-pressure laminate or powder coated metal bases. The top will feature an inset power module with outlets for power, usb, and telecom 	**Teknion Workshop Conference Table** • To match standards • Break room table w/ 4 prong base • H29" W120" D54” • Tabletop power/data/telecom modules • Plastic Laminate finish, painted metal frame 

LECT-1	**Lectern** Standard not provided	**Teknion Mobile Lectern** • H47.5" W22" D15” • Tabletop power/data/telecom modules • Plastic Laminate finish, painted metal frame • Lockable castors • No lock 

PM-1	**Power Module** • Power modules will be used to provide above-counter power and usb • access. • minimum 2 power outlets • minimum 2 usb ports • able to be grommet or edge-mounted 	**Teknion Tabletop Power Qube** • To match standards • 2 power+2 USB+1 data • Tabletop Power Modul  Power Port
CL-1	**Lounge Chair** Standard not provided	**Teknion StudioTK Pico** • High Back • Sled Base TKCA H • Fabric upholstery/painted metal frame 
CL-2	**Lounge Rest Chair** Standard not provided	**Teknion Zones Sled Lounge Chair ZNSW** • Fabric upholstery/painted metal frame 
CL-4	**Lounge Ottoman** Standard not provided	**Teknion Zones Sled Ottoman ZNSU** • Fabric upholstery/painted metal frame 

SCR-1	**Privacy Screen** Standard not provided	**Teknion Zones Freestadning Hinged Screen ZNGFH** • 48”x60” • Fabric upholstery/painted metal frame 
CL-5	**Sofa** Standard not provided	**Teknion Routes** • 3 Seat Sofa w/3 cushions CQSSLL • Fabric upholstery/painted metal frame  3-Seater with 3 Cushions
CL-6	**Arm Chair** Standard not provided	**Teknion Routes** • 1 Seat Sofa w/3 cushions CQSSLL • Fabric upholstery/painted metal frame  1-Seater
CL-7	**Soft Seating Bench** Standard not provided	**Teknion Banqs** • Single Sided Sofa • Two Seater • H44”,W72”D27” • Metal legs, faux leather seat, backrest fabric • Power module underneath the seat 

BANQ-1	**Banquette** Standard not provided	**Teknion Banqs** • Single Sided Sofa • Two Seater • H44”,W48”D27” • Metal legs, faux leather seat, backrest fabric 
ST-1	**Storage** Standard not provided	**Storage Solutions 4-Post shelving system** • W1219mm,D304mm,H1936mm • Standard Shelf Construction • Metal construction, paint finish • Hanging files – open shelf access style   **Hanging Files** Provides open-shelf access to all file folders contained in suspended compartments.
R-1	**Area Rug** Standard not provided	**Round Rug /TBD** • 12’ x18’

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this section.

1.2 SECTION INCLUDES

.1 This Section includes requirements for supply and installation of prefabricated engineered building systems with insulated wall and roof systems complete with metal trims and flashings.

1.3 REFERENCE STANDARDS

.1 Canada Green Building Council (CaGBC):

.1 LEED Canada Rating System, LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org.

1.4 PERFORMANCE REQUIREMENTS

.1 Have work of this Section engineered by a Professional Engineer (Contractor's Engineer) registered in the Province of the Work.

.2 Provide work capable of withstanding the effects of dead and live loads and stresses in accordance with minimum requirements of the building code.

.3 Wind Loads: Uniform wind load pressures for suction, impact and gusting, with a return period probability required by the governing building code.

.4 Snow, Rain and Ice Loads: Capable to support uniform snow and ice loads required by the governing building code.

.5 Thermal Movements: Allow for thermal movements resulting maximum change in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.

.6 Water Infiltration: Watertight to the interior under the interior and exterior design conditions in combination with movements occurring due to imposed loads.

1.5 QUALITY ASSURANCE

.1 Source Limitations: Provide work from a single manufacturer.

.2 Do not modify intended aesthetic effects, except with Contract Administrator's approval. If modifications are proposed, submit comprehensive explanatory data to for Contract Administrator's review.

.3 Do steel welding to CSA W59 by fabricators certified by the Canadian Welding Bureau to CSA W47.1.

.4 Do steel resistance welding to CSA W55.2 by fabricators certified by the Canadian Welding Bureau to CSA W55.3.

.5 Do aluminium welding by fabricators certified by the Canadian Welding Bureau to CSA W47.2.

.6 Accessibility Requirements: Where work is indicated to comply with accessibility requirements, comply with authorities having jurisdiction and code requirements.

.7 Electrical Components, Devices, and Accessories: ULC and CSA listed and labelled for intended use.

.8 Employ licensed electrician to wire and interconnect all operational and safety components for the work. Terminate wiring required for connection to control circuitry and power at NEMA enclosures. Ground all control wiring.

.9 Do wiring in strict conformity with requirement of the Electrical Code and Electrical Sections.

.10 Pre-Installation Meeting: Prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Contract Administrator of the date and time of the meeting.

.11 Manufacturer's Site Inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.12 Maintenance Seminars: Provide, to the City, training seminars and recommendations on Product maintenance procedures.

1.6 SUBMITTALS

.1 Shop Drawings: Bearing the seal and signature of the Professional Engineer (Contractor's Engineer) responsible for the engineering design of work of this Section. Include construction details, plans, elevations, sections, details, and attachments to work of other Sections, material descriptions, dimensions of individual components and profiles.

.2 Samples: Triplicate 300 mm x 300 mm (12" x 12") samples fully representing physical and chemical properties, finish, and colours.

.3 Submit Professional Engineer (Contractor's Engineer) letter under P. Eng seal that the installation meets the Contractor's Engineers' Design.

.4 Sustainable Design Submittals:

.1 LEED Submittals: Co-ordinate submittals requirements, submit LEED submittal forms for Credit MR 4 in accordance with the following:

.1 Recycled Content: provide listing of products incorporating recycled content. Include details of percentages of post-consumer and pre-consumer recycled content for materials and products. Indicate material and product costs.

.2 LEED Submittals: submit LEED submittal forms for Credit MR 5 in accordance with the following:

.1 Regional Materials: provide evidence that project incorporates required percentage 20% of regional materials/products, showing their cost, distances from extraction to manufacture and manufacture to project site, and total cost of materials for project.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Protect prefinished steel sheet finishes during fabrication, transportation, site storage and installation in accordance with CSSBI recommendations.

.2 Handle and protect galvanized materials from damage to zinc coating. During storage space surfaces of galvanized materials to permit free circulation of air.

1.8 WARRANTY

.1 Metal building system manufacturer shall provide a written weather tightness warranty for a maximum of 10 years against leaks in roof panels, arising out of or caused by ordinary wear and tear under normal weather and atmospheric conditions.

.2 Metal building system manufacturer shall provide a paint film written warranty for 25 years against cracking, peeling, chalking, and fading of exterior coating on painted roof and wall panels.

1.9 COORDINATION

.1 Coordinate installation of anchorages for work of this Section. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to site in time for installation.

2 Products

2.1 PREFABRICATED STEEL BUILDNG

.1 Overall Building Dimension: 4000 mm x 4000 mm x 2700 mm clearance ceiling height, location as indicated in Contract Drawings.

.2 Base Assembly: No perimeter frame, with surface of supporting concrete base as finished floor.

.3 Structural Framework Steel: CAN/CSA-G40.21, minimum 340 MPa yield strength, hot dipped galvanized to CAN/CSA-G164.

.4 Secondary Structural Connections: ASTM A307.

.5 Primary Structural Connections: ASTM A325M or ASTM A490M.

.6 Insulated Panels: Polyiso insulation core, sandwich by two layers of 26 gauge galvanized pre-painted steel sheet with siliconized polyester coating consisting of epoxy primer and silicone-modified, polyester-enamel topcoat, Colour Imperial White.

.1 Wall Panel: Overall thickness 100 mm (4”), with total R value 32.

.1 Acceptable Products:

.1 AWIP Mesa 40, by Vicwest

.2 QuadCore KS Series by Kingspan.

.2 Roof Panels: Overall thickness 152 mm (6”), with total R value 49. Minimum slope of 1/2:12.

.1 Acceptable Products:

.1 AWIP SR2 Standing Seam Roof by Vicwest

.2 KingSeam Series by Kingspan.

.7 Swinging Door: 44 mm (1-3/4”) thick; tubular-frame design fabricated from galvanized steel, insulated core.

.1 Door Hardware:

.1 3 x stainless steel butt hinges with non-removable pins.

.2 1 x closer with concealed hold open device.

.3 Three sides weather stripping around door opening.

.4 Threshold and kickplate to door opening width,

.5 1 x storeroom lockset, mortise type, with lever handle and removable cylinder capable of being master keyed.

.8 Accessories and Installation Materials:

.1 Bolts: Minimum 12 mm diameter, complete with nuts and washers, hot dipped galvanized.

.2 Fasteners: Non-corrosive concealed fasteners for insulated panels of stainless steel, aluminum or cadmium plated steel, as recommended by the manufacturer. Where exposed fasteners are required, provide fasteners in colours matching cladding work

.3 Welding Materials: CSA W59.

.4 Shop Prime Steel: One coat of primer paint to dry film thickness of 0.07 mm.

.5 Sealants: As recommended by sealant manufacturer for intended end use.

2.2 FINISHES

.1 Galvanized Steel Sheet Finishes: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A780.

.1 Finish: Refer to Section 09 90 00 Painting for requirements.

3 Execution

3.1 EXAMINATION

.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Set steel building system plumb, aligned, level and true to plane with full bearing on supports.

.2 Fasten steel building system to concrete bases with expansion anchors.

.3 Connect electrical power service to power distribution system according to requirements specified in Division 26.

3.3 INSTALLATION – INSULATED WALL PANEL

.1 Lay a ribbon of sealant on the face of the support at top and bottom of wall panels and around perimeter of openings. Line up and adjust interior liner sheets, press tightly against sealant and seal all vertical joints to form an air/vapour seal between liner and structural supports.

.2 Fasten panel to Z members and girts with concealed fasteners where possible and at spacings to suit loading requirements. Ensure complete nesting of exterior siding sheets on Z members and girts and sealed side lap joints.

.3 Align units end-to-end to provide accurate fit with corresponding sections parallel and straight. Keep exposed fasteners to a minimum. Maintain minimum end overlap of 50 mm (2”) and locate directly over supports.

.4 Cut and flash openings for doors, and the like. Provide all necessary closures, flashings, and trims, sealed to stop direct weather penetration.

3.4 INSTALLATION – INSULATED ROOF PANEL

.1 Install roof clips in accordance with recommendations of the panel manufacturer and in a manner to achieve waterproof integrity of the system.

.2 Fasten top and base clips members to structural supports with hex head fasterner at 300 mm (12”) centres and to suit loading requirements.

.3 Place panels to clips with concealed fasteners where possible and at spacings to suit loading requirements. Ensure complete nesting of exterior panels on clips and sealed side lap joints.

.4 Align units end-to-end to provide accurate fit with corresponding sections parallel and straight. Keep exposed fasteners to a minimum. Maintain minimum end overlap of 50 mm and locate directly over supports.

3.5 ADJUSTING AND CLEANING

.1 Adjust doors, and hardware to operate smoothly, easily, properly, and without binding. Confirm that locks engage accurately and securely without forcing or binding.

.2 Lubricate hardware and other moving parts.

.3 After completing installation, inspect exposed finishes and repair damaged finishes.

END OF SECTION

1 General

1.1 SUMMARY

.1 Vehicle lifts including safety equipment, controls and accessories of the following type:

.1 Three- post lifts

.2 Ensure that vehicle lifts are fully operational and functioning as intended by the manufacturer and the City, following Substantial Completion.

.3 Ensure that the equipment manufacturer provides a qualified technician on site for a minimum of two (2) weeks following Substantial Completion to assist in trouble shooting and adjustments to the equipment as needed.

1.2 RELATED REQUIREMENTS

.1 Section 03 30 00: Cast-In-Place Concrete

.2 Section 03 35 00: Concrete Finishing

.3 Section 05 50 00: Miscellaneous Metals

1.3 SUBMITTALS

.1 Product Data: Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.

.3 Installation methods.

.2 Shop Drawings: Submit drawings showing full layout of all lifts with dimensions and details shown for services and conduits between lifts and the control consoles.

.3 Operation and Maintenance Manual: Submit City's manual to include system operation, maintenance and trouble shooting, spare part numbers, drawings and schematics.

.4 Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

.1 Manufacturer Qualifications:

.1 The lift manufacturer shall

.1 Possess ISO-9001 certification and the proof of current certification shall accompany the bid Installer

.2 Have a minimum of 10 years of continuous design and fabrication of this type of equipment and systems for the Canadian commercial/industrial market.

.2 Installer Qualifications:

.1 Installation shall be performed by or under direct supervisions on qualified factory authorized and trained personnel.

.2 Installation shall be performed by or under the direct supervision of qualified red seal tradesperson for the type of work provided.

.3 Installation shall be site reviewed by authorized manufacturer’s representative.

.3 Manufacturer’s representative to:

.1 Convene pre-installation meeting one week prior to beginning on-site installation, with contractor's representative and Contract Administrator to verify project requirements.

.2 Supervise:

.1 Installation of equipment.

.2 Start-up testing.

.3 Performance verification testing.

.4 Commissioning.

.5 Certify installation.

.6 Conduct training sessions.

1.5 DESIGN CERTIFICATION:

.1 The lift shall be certified by ETL/Intertek or equivalent independent testing agency to:

.1 ANSI/ALI ALCTV-current edition Standard for Automotive Lifts: Safety Requirements for Construction, Testing and Validation.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Store products in manufacturer's unopened packaging until ready for installation.

.2 Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 SEQUENCING

.1 Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress

1.8 PROJECT CONDITIONS

.1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

.1 Manufacturers Extended Warranty: Lift system shall be warranted for a minimum period of two (2) years for parts and labour commencing on Substantial Completion, covering repair and/or replacement of equipment or material that causes any operational disturbances due to manufacturing defects or installation defects occurring within the extended warranty period.

2 Products

2.1 MANUFACTURERS

.1 Stertil Koni

.2 Rotary

.3 Approved equivalent.

2.2 DESIGN AND PERFORMANCE REQUIREMENTS

.1 Three Post Lift

2.3 TELESCOPIC PISTON TYPE IN-GROUND LIFTS

.1 Three Post Lift:

.1 For single full length concrete pit installation.

.2 Three lifting units in line with the longitudinal axis of the vehicle

.2 Each lifting assembly so equipped as to engage the axle and/or suspension as specified.

.3 Two of the three lifting units shall be moveable fore and aft to provide variable spacing between lifting units.

.1 Lifting Capacity:

.1 Lift shall be capable of raising 43,500 kg (96,000 lbs), with a maximum of 14,500 kg (32,000 lbs) per lifting unit.

.2 Unbalanced Loads, Moveable to Fixed: Lift shall be capable of raising 14,500kg (32,000 lbs) on one unit and 0 kg. (0 lbs) on the other unit.

.2 Performance:

.1 Travel range for the moveable piston assembly shall be suitable for the range of transit bus fleet vehicles.

.2 Lifting height shall be no less than 1775mm (70”) as measured from the top of the bolster at full rise to the finished floor.

.3 Lifting Rate: 1100 mm (45”) per minute, minimum.

.4 System shall be installable in a pit of maximum 1980mm (78”) of depth.

.5 Moveable and fixed lifting units synchronization: within 50mm (2”).

.6 Top of bolster flush with adjacent floor when down in the home position.

.4 Movable Lifting Units:

.1 The top of the bolster (saddle) assembly when fully lowered shall:

.1 At any location of its range of travel:

.1 preferably be flush with the surrounding floor, and

.2 not cause the upper most portion of any required axle engaging transit bus lifting adapters to be more than 113 mm above the top of floor, unless otherwise approved by the City.

.2 Corrosion Protected steel frame.

.3 Anodized aluminum, or corrosion protected steel covers:

.1 Engineered to accept a 3400 kg (7,500 lb.) point load on a contact area of 50 x 50mm (2 x 2 inches)

.2 Full-length interlocking hinge.

.3 Designed for smooth travel and to prevent jamming and twisting.

.4 Able to accept a 6123 kg. (13,500 lb.) drive over load on a 152 x 228mm (6 x 9 inch) contact area.

.5 UHMW slider blocks, or roller type supports with roller track debris protection.

.6 Guide system for travel within the recessed areas of the pit.

.7 Frame to pit cover transition plates.

.4 Flush with the finished floor within a tolerance of less than 3mm (1/8 inch). Covers that are lower than the finished floor shall not be acceptable.

.5 Carriage for the movable lifting unit and the trench covers shall utilize a non-metallic slide assembly bearing on stainless steel for corrosion prevention.

.6 Positive mechanical or hydraulically carriage drive, actuating both sides of the movable carriage and covers.

.1 Designed to minimize fouling from overhead contaminants.

.7 Power and control distribution:

.1 Hydraulic and compressed air service lines shall be fed from the floor mounted control console to the movable containment box through one PVC chase way.

.2 All low voltage, intrinsically safe electric service lines shall be fed from the floor mounted control console to the movable containment box through one ¾ inch rigid conduit installed to meet local requirements.

.8 Steel containment box for the movable lifting unit shall be equipped with a pneumatic liquid detection device that shall inform the operator of accumulation of liquids in the containment box.

.9 Movable containment box shall be equipped with a fixed suction tube to allow evacuation of liquids.

.10 Movable containment box shall be internally sloped to allow liquids to accumulate at the low point. Low point shall be located underneath a stationary trench cover for ease of access.

.5 Fixed Lifting Unit:

.1 Shall be mounted in a corrosion protected steel floor frame.

.6 Hydraulic System:

.1 Power units:

.1 Individual power units for each piston

.2 From established power unit package manufacturer.

.3 Electrically powered, 575/3/60

.4 TEFC motor

.5 Electrical valve controls.

.6 Submersed pump

.7 All components located within floor mounted control console,

.2 Pistons:

.1 High pressure, low volume design is preferred.

.1 Related oil volume to full height: approximately 19 Litres (5 USG) of hydraulic fluid.

.2 Telescopic pistons, one per lifting location.

.3 Seals protected from contamination.

.3 Hydraulic fluid: Bio-degradable, environmentally-friendly

.4 Hoses: reinforced construction with standard industrial hydraulic fittings throughout.

.1 Hoses feeding the movable piston carriage shall be supported and contained by a hose carrier to prevent the hoses from dragging or tangling.

.7 Adapters and bolsters:

.1 Provide a variety of axle engaging accessory adapters designed to raise low profile transit buses.

.2 Adapters shall be either axle or frame oriented. Spinning adapters shall not be acceptable due to risk of accidental rotation during vehicle spotting and setup.

.3 Base adapter shall have at least a five-hole pattern that will allow every accessory adapter to be used in the reverse direction, allowing up to eight positions of the accessory adapter on the base adapter.

.4 Sliding base adapters shall be restrained to prevent over extension.

.5 Adapter Adjustment: Minimum 13.5 inches (337 mm); Maximum 54 inches (1,372 mm).

.6 Bolster Width: 40 inches (1,016 mm) minimum.

.7 Bolster and base adapters for the fixed piston shall recess below finished floor and be covered by cover doors when not in use.

.8 Cover doors shall be rated for similar loading 3400 kg (7,500 lbs.) point load on a contact area of 50 x 50mm (2 x 2 inches).

.9 Cover doors shall be stored in a recessed storage area located beside the bolster, to reduce the risk of tripping.

.10 Bolster for the movable piston shall fully recess, flush with the floor, at any location in the range of travel of the post.

.11 Covers rated for similar loading 3400 kg (7,500 lbs.) point load on a contact area of 50 x 50mm (2 x 2 inches).shall be supplied with the lift.

.12 These covers shall be installed and removed by hand from a storage area located below the bolster, to reduce the risk of tripping.

.8 Controls:

.1 Conform to all current CSA, NEC, UL 201 and OSHA codes.

.2 PLC operated and continuously monitor all operating functions and safety systems of the lifting units.

.3 Touchless ultrasonic sensors to constantly monitor the elevation of all lifting units to ensure synchronized operation.

.4 Shall allow the user to adjust the sensitivity of the electronic synchronization without the use of special tools, within the absolute limits of ANSI/ALI ALCTV standard.

.5 Ability to receive regular software updates/upgrades as control system advances become available. All updates/upgrades shall be possible through data transfer without the need for component replacement.

.6 On the face of the control console, control elements shall include:

.1 "UP" button.

.2 "Down" button.

.3 “Lock release” button.

.4 “Confirm” button

.7 Industrial grade High definition 178mm (7 inch) LCD screen touch screen.

.1 Shall provide systems information, but operation of the lift shall be initiated by the primary operational buttons.

.2 Shall include a removable micro-SD memory card for storage of user configurable information.

.3 Shall be capable of providing the following functions:

.4 "Lifting unit selection" indicator:

.1 Displays to the operator which lifting units in the lift have been selected for operation.

.2 Illustrates the ability to operate the lifting units singularly, or groups of lifting units as synchronized sets.

.5 "Lifting unit height" indicator:

.1 Displays the height of each individual lifting unit, and any preset height restrictions.

.6 "Lifting units fully lowered" indicator:

.1 Displays that all lifting units are fully retracted into the ground.

.7 "Error message" indicator:

.8 Displays when a fault code has been registered by the control system, including fault description on the screen.

.9 One-touch access to the Guide screen:

.1 City information

.2 Contact information for service provider

.3 Equipment time log including lifting unit run times

.10 One-touch access to the Settings screen for authorized access control of:

.1 Language (English, Spanish, French) displayed on the screen as well as the units of measure for height and weight (imperial or metric units).

.2 Settings screen options: ability to retract the mechanical locks during raising for reduced noise, as well as to set a restricted maximum lifting height.

.3 Shop and Assistance screens:

.1 control the service settings.

.2 Edit of the information displayed on the City's field.

.4 One-touch restricted access to the Assistance configuration screen which displays various options

.5 Screen 1

.1 Initiation of crush protection which guards against a crushing hazard during lowering when using the optional remote control.

.2 Ability to disable height difference monitoring to aid in trouble shooting.

.6 Screen 2

.1 Ability to view lift system run time to properly plan for lift system maintenance.

.2 Ability to view individual lifting unit motor run time to properly plan for lift system maintenance.

.7 Screen 6

.1 This screen shall allow back up of the operating system

.8 Screen 7

.1 This screen shall display operating system information

.11 The enclosure for electrical control components shall be IP 54 rated.

.12 The control console shall be equipped with a main power disconnect switch which interrupts all incoming power. Main power disconnect shall be lock-out capable.

.13 Control console access panels shall have key-hole slots and recessed handles for easy removal and installation.

.14 The control system shall automatically prohibit horizontal movement of the movable lifting unit when raised above 12 inches (305 mm) above finished floor. This parameter shall be user programmable without the use of special tools.

.15 The lift, when fitted with the proper electrical motors, shall operate at the following voltages: 575V (3 phase).

.9 Safety Devices:

.1 Each lifting unit shall be equipped with an independent mechanical locking rod with the first lock position at no more than 250mm (10 inches) of rise.

.2 Mechanical lock stops at a maximum lifting interval of 75mm (3 inches)

.3 Pneumatic mechanical locking release assembly.

.1 Shall be easily accessible to allow complete removal from floor level, for ease of maintenance.

.4 All push buttons shall be of momentary contact, dead man type.

.10 Remote Control:

.1 Radio or cabled.

.2 Lift shall be equipped with an ergonomic industrial remote control, rated for use in NEC Class 1, Div. 2, hazardous locations.

.3 Cabled remote control shall be connected to the control console through a multi-conductor cable with military-style DIN connector.

.1 Cable length: minimum 10.6m (35 feet)

.4 Remote control shall allow full function control of the lift, with the following:

.1 Push/Pull E-Stop Button

.2 Push buttons for Lift Raise, Lower and Unlock

.3 Selector button for synchronized (group) or single operation

.4 Push buttons for hydraulic movable carriage drive

.5 Remote control shall be equipped with an emergency E-Stop button that de-energizes power to all outputs of the PCB.

.6 The control box shall have a provision to disable operation of the remote control during lowering when the bolster is below 18 inches (457 mm) above finished floor.

.11 HOME Beacon Stack Light:

.1 Lift shall be equipped with an external HOME beacon stack light.

.1 Green indication when all lifting units are fully retraced.

.2 Red indication if not fully retracted.

.2 The beacon light shall have the option to be mounted in a remote location (e.g. by the

.3 bay door) for optimum visibility.

3 Execution

3.1 QUALITY ASSURANCE

.1 Installer’s qualifications:

.1 Factory trained authorized company.

.2 Company insured for completed operations of installing lift.

.3 Install in accordance with manufacturer's instructions. Test for proper operation, and re-test if necessary until satisfactory results are obtained.

.2 Manufacturer’s qualifications:

.1 The manufacturer shall be a member, in good standing, of ALI.

.2 The manufacturer of lifting system shall have been certified ISO 9001. ISO 9001 certification shall be submitted at the time of the bid.

.3 Installation in accordance with ANSI/ALI ALIS 2019.

3.2 PREPARATION

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION AND TESTING

.1 Install in accordance with manufacturer's instructions.

.1 Perform and submit manufacturer’s installation and testing checklist

.2 Test for proper operation, and re-test if necessary until satisfactory results are obtained.

.3 Perform load test at maximum rated capacity.

.4 Provide load testing documentation and certification.

3.4 PROTECTION

.1 Protect installed products until completion of project.

.2 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

1 General

1.1 SUMMARY

.1 Vehicle lifts including safety equipment, controls and accessories of the following type:

.1 Platform (runway) drive-on bus lifts.

.2 Ensure that vehicle lifts are fully operational and functioning as intended by the manufacturer and the City, following Substantial Completion.

.3 Ensure that the equipment manufacturer provides a qualified technician on site for a minimum of two (2) weeks following Substantial Completion to assist in trouble shooting and adjustments to the equipment as needed.

1.2 RELATED REQUIREMENTS

.1 Section 03 30 00: Cast-In-Place Concrete

.2 Section 03 35 00: Concrete Finishing

.3 Section 05 50 00: Miscellaneous Metals

1.3 SUBMITTALS

.1 Product Data: Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.

.3 Installation methods.

.2 Shop Drawings: Submit drawings showing full layout of all lifts with dimensions and details shown for services and conduits between lifts and the control consoles.

.3 Operation and Maintenance Manual: Submit City's manual to include system operation, maintenance and trouble shooting, spare part numbers, drawings and schematics.

.4 Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

.1 Manufacturer Qualifications:

.1 The lift manufacturer shall

.1 Possess ISO-9001 certification and the proof of current certification shall accompany the bid Installer

.2 Have a minimum of 10 years of continuous design and fabrication of this type of equipment and systems for the Canadian commercial/industrial market.

.2 Installer Qualifications:

.1 Installation shall be performed by or under direct supervisions on qualified factory authorized and trained personnel.

.2 Installation shall be performed by or under the direct supervision of qualified red seal tradesperson for the type of work provided.

.3 Installation shall be site reviewed by authorized manufacturer’s representative.

.3 Manufacturer’s representative to:

.1 Convene pre-installation meeting one week prior to beginning on-site installation, with contractor's representative and Contract Administrator to verify project requirements.

.2 Supervise:

.1 Installation of equipment.

.2 Start-up testing.

.3 Performance verification testing.

.4 Commissioning.

.5 Certify installation.

.6 Conduct training sessions.

1.5 DESIGN CERTIFICATION:

.1 The lift shall be certified by ETL/Intertek or equivalent independent testing agency to:

.1 ANSI/ALI ALCTV-current edition Standard for Automotive Lifts: Safety Requirements for Construction, Testing and Validation.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Store products in manufacturer's unopened packaging until ready for installation.

.2 Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 SEQUENCING

.1 Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress

1.8 PROJECT CONDITIONS

.1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

.1 Manufacturers Extended Warranty: Lift system shall be warranted for a minimum period of two (2) years for parts and labour commencing on Substantial Completion, covering repair and/or replacement of equipment or material that causes any operational disturbances due to manufacturing defects or installation defects occurring within the extended warranty period.

2 Products

2.1 VERTICAL HALF-SCISSORS PLATFORM LIFT

.1 General Description:

.1 Hydraulic, vertical half-scissors heavy-duty platform lift

.2 Interior installation.

.3 To elevate buses up to 60 feet in length, occasionally large trucks, and other heavy-duty vehicles for cleaning.

.4 Complete with jacking beams.

.5 One wash bay/wet location unit and one regular environment unit.

.6 Lift shall

.1 Rise in a vertical fashion and be specifically designed for wet environments.

.2 Be flush mounted recessed as indicated on the drawings.

.3 Be totally open floor design with no obstructions between lifting platforms and no crossbeams either in the front or the rear of the platforms.

.7 The maximum lifting height of the lift system shall be programmable to the height specifications as requested by user.

.2 Lifting Capacity:

.1 Minimum nominal lifting capacity of:

.1 34,100 kg (70,000 lbs)

.3 Platform:

.1 Continuous steel plate surface with front end stops

.2 Front wheel swivel plate (for steering box adjustments)

.3 Wheel chocks.

.4 Minimum lifting height: 1750 mm (69 inches).

.5 Platform dimensions:

.1 Length: 14.5 m (47 ½ feet)

.2 Width : 760mm (30 inches).

.4 Lift Mechanism:

.1 Electrically powered hydraulic power pack.

.1 Low volume hydraulic fluid system

.2 TEFC motor with submersed pump.

.3 Electrically controlled directional control valves.

.4 Flow control valves

.5 Pressure relief (safety) valve.

.2 Shall provide smooth lifting and lowering under all loads up to maximum load, without any pulsation, jerks, or unsteady lifting.

.3 Piston type hydraulic lifting cylinders, in each scissor assembly;

.1 Designed to prevent leakage in the case of piston damage.

.4 Rotating axles shall be made of stainless steel.

.5 Jacking beams:

.1 Self-powered and air-hydraulic.

.2 Tandem vertical pistons with a combined capacity of up to 16,000 kg (35,200 lbs.)

.3 Flow divider valve to maintain synchronization of pistons in raising and lowering mode; maximum pressure valve shall prevent lifting of loads if loads exceed rated capacity of jack; check valves in each piston shall prevent the accident descent of load.

.6 Electrical and Controls:

.1 Main power: 575V (3 phase)

.2 Electrical and Control panel shall be rated IP 65.

.3 Microprocessor controls to provide various safety and operational requirements.

.4 Maximum control voltage 24 volts

.5 Dedicated floor mounted control pedestal.

.6 Each control pedestal shall have as a minimum:

.1 System disconnect.

.2 “Power-on" LED pilot lamp.

.3 "up" button

.4 "down" button

.5 Lock release button

.6 Lighting switch.

.7 Safety Devices:

.1 Independent and fail-safe mechanical safety device on each half scissor.

.2 Safety device shall be totally independent from the lifting drive system.

.3 A locking catch shall be free to engage all of the teeth of the locking strip attached to the half scissor.

.4 Shall be activated in no less than 3 inches (76 mm)

.5 of lifting height.

.6 Each lifting device shall be provided with a position measuring device to synchronize the height of the 4 lifting devices.

.7 Automatic foot-guard protection.

.8 Locking mechanism

.8 Special Finish for wet environments

.1 Repair Bay #6 lift only.

.2 Hot dip galvanized:

.1 platforms

.2 wheel chocks

.3 Zinc rich primer and factory top coat.

.1 Upper and lower locking mechanisms

.2 Pull bar for scissors assembly

.3 Epoxy costing designed and applied for submerged steel applications:

.4 Leg assemblies

.4 Stainless steel:

.1 Anchor plates

.2 Control box enclosure with hinged cover for lamps and button

.9 Acceptable Product

.1 Stertil-Koni

.2 PKS

.3 Rotary

3 Execution

3.1 QUALITY ASSURANCE

.1 Installer’s qualifications:

.1 Factory trained authorized company.

.2 Company insured for completed operations of installing lift.

.3 Install in accordance with manufacturer's instructions. Test for proper operation, and re-test if necessary until satisfactory results are obtained.

.2 Manufacturer’s qualifications:

.1 The manufacturer shall be a member, in good standing, of ALI.

.2 The manufacturer of lifting system shall have been certified ISO 9001. ISO 9001 certification shall be submitted at the time of the bid.

.3 Installation in accordance with ANSI/ALI ALIS 2019.

3.2 PREPARATION

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION AND TESTING

.1 Install in accordance with manufacturer's instructions.

.1 Perform and submit manufacturer’s installation and testing checklist

.2 Test for proper operation, and re-test if necessary until satisfactory results are obtained.

.3 Perform load test at maximum rated capacity.

.4 Provide load testing documentation and certification.

3.4 PROTECTION

.1 Protect installed products until completion of project.

.2 Touch-up, repair or replace damaged products before substantial completion.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 07 00 – Mechanical Insulation

.2 Section 01 91 00 – General Commissioning Requirements

.3 Section 22 08 00 – Commissioning of Plumbing

.4 Section 23 08 00 – Commissioning of HVAC

.5 Section 23 52 16 – Commissioning of Boiler and Interconnected pressure piping

.6 Section 25 08 00 – Commissioning of Integrated Automation

.7 Section 26 08 00 –Commissioning of Electrical

1.2 REFERENCE STANDARDS

.1 Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

.2 O.Reg 213/91 Occupational Health and Safety Act Construction Projects.

.3 CAN4-S115-M85 Standard Method of Fire Tests of Firestop Systems.

.4 OSHA Occupational Safety and Health Administration.

.5 CAN3-Z166.1 and 2-M85 Powder Actuated Tools – Use and Handling.

1.3 CODES, STANDARDS AND LAWS

.1 All work shall be carried out in accordance with the applicable regulations of the following authoritative bodies, codes in effect at the time of Tender, and any other Authority having jurisdiction:

.1 National Building Code of Canada 2020

.2 National Plumbing Code of Canada 2020

.3 National Fire Code 2020

.4 Worker's Compensation Board

.5 Local Building By-Laws

.6 Canadian Standards Association

.7 CSA Gas Code B149.1

.8 CSA Mechanical Refrigeration Code B52

.9 CSA B51: Boiler, Pressure Vessels and Pressure Piping Code.

.10 CSA B139: Installation code for Oil-burning Equipment

.11 Canadian Safety Standard (CSA):

.1 CAN/CSA C22.2.CAN/CSA C747, Energy Efficiency Test Methods for Small Motors.

.2 CAN/CSA C390, Test methods, marking requirements and energy efficiency levels for three-phase induction motors.

.12 Electrical Equipment Manufacturers' Association Council (EEMAC).

.13 Institute of Electrical and Electronic Engineers (IEEE).

.1 IEEE 112, Standard Test Procedure for Polyphase Induction Motors and Generators.

.14 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)

.15 Inspection and Technical Services Manitoba (ITSM)

.16 National Electrical Manufacturers Association (NEMA).

1.4 WORK STANDARDS

.1 All Codes and Standards referred to in this Section are the latest edition of the Codes and Standards in effect at the time of tendering this Contract.

.2 All mechanical piping system Work, including equipment, must comply in all respects with requirements of the Inspection and Technical Services Manitoba (ITSM), and CSA Standards B51, Boiler, Pressure Vessels and Pressure Piping Code. Where required, fittings, valves, equipment, etc., must bear a CRN number.

.3 All electrical items associated with mechanical equipment shall be CSA (or equivalent agency certified electrically), or bear a stamp to indicate special Electrical Safety Authority approval.

1.5 DEFINITIONS

.1 The following are definitions of words found in Sections of Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems Divisions and on associated Drawings:

.1 “Concealed” – means Work hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.

.2 “Exposed” – means Work normally visible, including Work in equipment rooms and similar spaces.

.3 “Supply” – means supply only.

.4 "Finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished.

.2 Wherever the words “indicated”, “shown”, “noted”, “listed”, or similar words or phrases are used in the Specification Sections they are understood, unless otherwise defined in the Contract Documents, to mean that the product referred to is “indicated”, “shown”, “listed”, or “noted” on the Drawings.

.3 Wherever the words “approved”, “satisfactory”, “as directed”, “submit”, “permitted”, “inspected” or similar words or phrases are used in the Specification Sections they are understood, unless otherwise defined in the Contract Documents, to mean that Work or product referred to is “approved by”, “inspected by”, etc., the Contract Administrator.

1.6 WORKPLACE SAFETY

.1 Comply with the requirements of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) regarding the use, handling, storage and disposal of hazardous materials.

.2 Comply with all requirements enacted under the Occupational Health and Safety Act.

1.7 APPLICATION

.1 This Section specifies requirements, products, common criteria and characteristics, and methods and execution that are common to one or more Sections of Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems Divisions and it is intended as a supplement to each Section and shall be read accordingly

1.8 PLANNING AND LAYOUT OF WORK

.1 The exact locations and routing of mechanical and electrical services shall be properly planned, coordinated and established with all affected trades prior to installation such that the services will clear each other as well as any obstructions. Generally, give the right-of-way to piping requiring uniform pitch and locate and arrange other services to suit.

.2 All shut-off valves, balancing devices, air vents, equipment and similar products, particularly such products located above suspended ceilings, must be located for easy access for servicing and/or removal. Products which do not meet the location's requirements shall be relocated at no cost.

.3 Provide anchors, expansion/ contraction, pipe alignment guides on all piping systems throughout the project. Submit shop drawings depicting expansion/ contraction layouts and calculations with all equipment/ contraction devices.

.4 Provide pipe "U" or "V" shape multi-directional expansion/ contraction devices and long ductwork flexible connection at all building expansion joints to allocate for maximum expected building movements.

1.9 DOCUMENTS

.1 The Contract Drawings are performance Drawings, diagrammatic, and show approximate locations for equipment and materials. The Drawings are intended to convey the scope of work and do not necessarily show architectural and structural details. The locations of materials and equipment shown may be altered (when revised layouts have been submitted and approved), to meet requirements of the material and/or equipment, other equipment and systems being installed, and of the building. Provide all fittings, offsets, transformations, and similar items required as a result of obstructions and other architectural or structural details but not shown on the Mechanical Drawings.

1.10 ACCEPTABLE PRODUCT MANUFACTURERS

.1 Products scheduled and/or specified on the Drawings and in the Sections of Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems Divisions have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard. In most cases, acceptable manufacturers are stated for any product specified by manufacturer's name and model number. The Contract price may be based on products supplied by any of the manufacturers named as acceptable for the particular product. If acceptable manufacturers are not stated for a particular product, base the Contract price on the products supplied by the specified manufacturers.

.2 If products supplied by a manufacturer named as acceptable in any Section of Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems Divisions are used in lieu of the manufacturer specified, be responsible for ensuring that the substituted product is equivalent in performance and operating characteristics (including energy consumption if applicable) to the specified product, and, it is to be understood that any additional costs, and changes to associated or adjacent Work resulting from provision of products supplied by a manufacturer other than the specified manufacturer is included in the Contract price. In addition, in equipment spaces where products named as acceptable are used in lieu of specified products and the dimensions of such products differ from the specified products, prepare and submit for review, accurately dimensioned layouts of rooms affected and bear all the cost associated with all required changes inclusive of power supply, acoustical performance, clearances, structural reinforcement, energy and operational costs.

1.11 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Submit the following for review:

.1 Shop drawings for all products specified in this Section.

.2 Location drawings for all required sleeves and formed openings in new poured concrete or precast concrete construction shall be provided within via detailed sleeving shop drawings.

.3 Samples of materials and any other items as specified in other Sections of this Division.

.4 Globally Harmonized System of Classification and Labelling of Chemicals (GHS) MSDS – Material Safety Data Sheets for all products where required, and maintain one copy at the site in a visible and accessible location and available to all personnel.

.5 A list of equipment identification nameplates indicating proposed wording and sizes.

.6 A list of pipe and duct identification colour coding and wording.

.7 A proposed valve tag chart and a list of proposed valves, instruments, equipment and control panels tag numbering and identification wording.

.8 A clean “reviewed” copy of each shop drawing for insertion into the O&M instruction manual.

.9 Additional submittals as per Section 1.10 B.

1.12 SHOP DRAWINGS

.1 The following shall be read in conjunction with the wording on the engineer's shop drawing review stamp applied to each and every mechanical work shop drawing submitted:

.1 “This review is for the sole purpose of ascertaining conformance with the general design concept. This review does not approve the detail design inherent in the shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of its responsibility for errors or omissions in the shop drawings or of its responsibility for meeting all requirements of the Contract Documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all Contractors.”

1.13 OPERATING AND MAINTENANCE INSTRUCTION MANUALS

.1 Refer to section 01 78 00 – Closeout Submittals

1.14 AS BUILT DOCUMENTATION

.1 Refer to section 01 78 00 – Closeout Submittals

1.15 EQUIPMENT AND SYSTEM STARTUP AND COMMISSIONING

.1 An independent Commissioning Agent (“Commissioning Agent”) shall be retained by the Construction Contractor.

.2 The work for the independent Commissioning Agent is specified in Section 01 91 00 – General Commissioning Requirements. Carefully read Section 01 91 00, and all other commission specification sections, and provide for all labour to physically perform start-ups and performance testing, supply of equipment manufacturer’s representatives and technicians on-site, services, etc., which are indicated as being supplied by the Construction Contractor, including:

.1 Data and shop drawings for operation and maintenance manuals.

.2 Marked-up white print "record drawings" prepared on site during construction.

.3 All test data and certificates.

.3 The majority of the Commissioning Work specified in Section 01 91 00, and all other commission specification sections, must be complete prior to application for Substantial Performance of the Work.

2 Products

2.1 PIPE SLEEVES

.1 Pipe Sleeves (Floors/Slab-on-Grade):

.1 Minimum 1.6mm thick (16 ga) steel with an integral flange at one end to secure the sleeve to formwork construction. Provide puddle flange (water stop plate) at the sleeve midpoint and galvanized steel for waterproofed slab applications.

.2 Alternatively provide factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.

.2 Waterproof Pipe Sleeves (Above Grade Walls): Minimum 1.6mm thick (16 ga) galvanized steel pipe or galvanized sheet metal (if sheet metal is used lap and spot weld). Provide 20mm (3/4 in.) lip flange as necessary to suit installation. The sleeve shall be painted to match the exterior wall finish as closely as possible.

.3 Non-Waterproof Pipe Sleeves (Above Grade Walls): Minimum 1.6mm thick (16 ga) steel pipe or sheet metal (if sheet metal is used lap and spot weld). Provide 20mm (3/4 in.) lip flange as necessary to suit installation.

.4 Non-Waterproof Pipe Sleeves (Below Grade Walls): Schedule 40 mild steel pipe with a welded-on square steel anchor/water stop plate at the sleeve midpoint, cold galvanized c/w non-crosslink polyethene foam packing material, held in place with UV resistant poly propylene adhesive film (eg. Tuck Tape).

.5 Waterproof Pipe Sleeves (Below Grade Walls): Schedule 40 mild steel pipe with a welded-on square steel anchor/water stop plate at the sleeve midpoint, hot-dip galvanized c/w modular waterproof seal.

2.2 FIRESTOPPING AND SMOKE SEAL MATERIALS

.1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115 for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding construction.

.2 Pipe insulation forming part of a ULC fire and smoke seal assembly is specified in Section 20 07 00.

2.3 WATERPROOFING SEAL MATERIALS

.1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so that when the bolts are tightened the links expand to seal the opening watertight. The seal assemblies shall be selected to suit the pipe size and the sleeve size or wall opening size. Acceptable products are:

.1 Thunderline Corp. (Power Plant Supply Co.) “LINK SEAL” Model S.

.2 The Metraflex Co. “MetraSeal” type ES.

2.4 PIPE ESCUTCHEON PLATES

.1 Two-piece chrome plated brass or #4 finish type 302 stainless steel plates with screws, each sized to cover the pipe sleeve or wall or slab opening, and to fit tightly around the pipe or pipe insulation.

2.5 EQUIPMENT DRIVE GUARDS AND ACCESSORIES

.1 For V-belt drives - removable, four sided, fully enclosed, galvanized sheet steel guards to OSHA standards, complete with 115 mm (4.5”) diameter tachometer openings covered with removable perforated galvanized plates at each shaft location.

.2 For flexible couplings - removable "U" shaped galvanized steel guards with a 2.3 mm (0.093") thick frame and expanded mesh face.

.3 For exposed fan blades, unless otherwise specified in the Contract Documents - removable 12 mm (0.5”) galvanized steel wire mesh with galvanized steel frames.

2.6 COMMON ELECTRICAL REQUIREMENTS

.1 Division 26 – Electrical, shall provide all line side power wiring for equipment provided by Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems Divisions.

.2 Motor control center, starters, VFDs, disconnects switches shall be provided by Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems Divisions and shall meet the Building Automation and Controls requirements.

.3 Load side power wiring shall be under Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems Divisions shall provide all local disconnect switches, control panels and VFD’s for equipment as required.

.4 Control wiring of local safeties and interlocks for packaged equipment shall be provided under the respective Sections unless otherwise specified in the Contract Documents.

.5 Conduit and wiring materials and methods shall be in strict accordance with the requirements of Division 26 - Electrical.

.6 Check all wiring diagrams and control diagrams submitted in shop drawing form. Before submitting these shop drawings to the Contract Administrator, submit these drawings to Division 26 – Electrical Contractor for approval. Have these drawings stamped by Division 26 – Electrical Contractor as verification of their approval before forwarding to the Contract Administrator. Co-operate in the commissioning of all electrically driven equipment with Division 26 – Electrical.

2.7 COMMON MOTORS REQUIREMENTS

.1 General:

.1 The efficiency of single phase motors to 0.746 kW (1 HP) is to be in accordance with CAN/CSA – C747. The efficiency of all three phase motors 0.746 kW (1 HP) and larger shall be equal to or exceed the NEMA Premium Efficiency designation as tested in accordance with CSA C390 or IEEE 112.

.2 Motors:

.1 Unless otherwise specified in the Contract Documents, motors shall conform to EEMAC Standard MG1, applicable IEEE Standards, and applicable CSA C22.2 Standards.

.2 Vertically mounted and submersible motors shall be purposely designed for mounting in this attitude.

.3 Single Phase Motors: Unless otherwise specified in the Contract Documents, motors smaller than 0.373 kW (0.5 HP) shall be 115 volt, continuous duty capacitor start type with an EEMAC 48 or 56 frame size, solid base, heavy-gauge steel shell with solid die-cast end shields, dynamically balanced die-cast rotor, integral automatic reset thermal overload protection, Class “B” insulation, and a 1.15 service factor at 40°C (104°F) ambient temperature.

.4 Three Phase Motors: Unless otherwise specified in the Contract Documents, motors 0.373 kW (0.5 HP) and larger shall be totally enclosed, fan cooled (TEFC), 3 phase, T-frame, squirrel cage continuous duty induction motors suitable for voltages indicated on the Drawings, NEMA Premium designs, EEMAC Design "B" for normal starting torque or Design "C" for high starting torque as required by the application, each complete with Class "F" insulation or better with Class "B" temperature rise, a 1.5 service factor at 40°C (104°F) ambient temperature, windings dipped and baked a minimum of two times in a Class "H" varnish up to frame 256T and three times on larger frame sizes. All motor windings shall be suitable for use on VFD. Regreasable (on frames 284T and above), open or shielded ball or roller bearings with grease fittings to permit relubrication without dismantling the motor and while in operation, bearings shall have an L10 life of 40,000 hours on belt drive service and 100,000 hours on direct coupled service in accordance with AFBMA, a cast iron frame (Grade 25 or better) with cast iron feet where required, cast iron end bracket and precision machined bearing fits, and precision balanced carbon steel shaft assembly with die-cast aluminum rotor windings, two breather holes shall be provided at the lowest points in the motor frame or bracket, shaft slingers on DE shaft, lifting bolts required on frames 182T and above. Conduit box volume shall be one size larger than NEMA standard. Zinc-dichromate plated hardware shall be provided on all motors.

.5 Explosion-Proof Three Phase Motors: Totally enclosed fan cooled (TEFC) motors in accordance with CSA C22.2 No. 145-11, generally as specified above with NEMA Premium efficiencies for 3 phase motors but suitable for use in Class 1 Groups C & D and Division I, Class II, Groups F & G (Zone 1, Class I, IIC). Division 2, Class I, Groups A, B, C & D, Division 2, Class II, Groups F & G hazardous locations and with a 1.15 service factor at 40 degrees C (104 degrees F) ambient temperature.

.6 Motor Efficiency: The efficiency of single-phase motors to 0.746 kW (1 HP) is to be in accordance with CAN/CSA – C747-09. The efficiency of all three phase motors 0.746 kW (1 HP) and larger is to be equal to or exceed the NEMA Premium Efficiency designation as tested in accordance with CSA C390-10.

.7 Thermistor Protection: Motors 22.37 kW (30 HP) and larger, as scheduled in the Contract Drawings, shall be complete with a heat sensing Siemens PTC thermistor (or an approved equivalent) in the end turn of the stator winding for each phase and connected in series inside the motor with two marked leads brought out to the main motor conduit box. Incorporate the thermistor protection in safety circuits wiring.

.8 Motors for VFD's: Motors for equipment with variable frequency drives shall be inverter duty, quantified by CSA for operation from a variable frequency drive of the type specified in the Contract Documents. Motors on VFD service above 150 kW (200 HP) shall be provided with insulated bearings to mitigate any electrical discharge machining (EDM) issues due to the discharge of VFD induced shaft voltage. Motors shall be provided with shaft grounding devices to create a path from the motor shaft to ground to allow discharge of VFD induced shaft voltage.

.9 Corrosion Protection: Motors for equipment which is scheduled, specified or located exposed to the environment (inclusive of air stream) or located in corrosive or humid indoor environment, with a corrosion resistant coating or constructed from corrosion resistant materials are to be factory coated with a primer and epoxy paint finish.

.10 Motor Speed: Motors shall be operated withing their synchronous speed. If vendor select VFD operated motos to operate above the motor synchronous speed, vendor shall provide written acceptance confirmation and extended warranty from the motor manufacturer. Cautionary label shall be attached to the equipment and VFDs shall be programmed and setup accordingly.

.11 Acceptable Manufacturers: Acceptable motor manufacturers are:

.1 TECO-Westinghouse Motors (Canada) Inc.

.2 GE Canada Inc.

.3 Baldor Electric Company

.4 U.S. Motors (Nidec Motor Corporation)

.5 Emerson Electric Company

.6 Weg Canada Ltd.

.7 Marathon Electric Corporation

.8 Leeson Electric Corporation

.9 Toshiba International Corporation

.10 Brook Crompton (Canada) Inc.

.3 Drive Guards and Accessories:

.1 For V-belt drives - removable, four sided, fully enclosed, galvanized sheet steel guards in accordance with OSHA standards, complete with 115 mm (4.5") diameter tachometer openings covered with removable perforated galvanized plates at each shaft location.

.2 For flexible couplings - removable "U" shaped galvanized steel guards with a 2.3 mm (0.093") thick frame and expanded mesh face.

.3 For exposed fan blades, unless otherwise specified in the Contract Documents, removable 12 mm (0.5") galvanized steel wire mesh with galvanized steel frames.

2.8 SOILS

.1 Refer to Manitoba Standards, Civil Division and Structural Division for requirements.

.2 Requirements for Pea Gravel: Granular, well-graded clean rounded pea gravel or stone with not more the 2% material that will pass 75 um (No. 200) sieve, maximum 6 mm (¼ in.), containing not other deleterious material, and subject to testing that specified density can be achieved without compaction.

.3 Requirements for Sand Fill: Uniform quality and unwashed river sand or any clean sand containing less than 5% organic materials, clay or silt (passing 125 um sieve) is acceptable. It can contain a limited amount of small stones or rocks as it comes from the pit. Sharp, clean, coarse sand, water washed, free from clay, salts and organic matter, and in accordance with CSA A179-93 for masonry sand is also acceptable.

3 Execution

3.1 INSTALLATION OF PIPE SLEEVES

.1 Where pipes pass through concrete and/or masonry surfaces provide pipe sleeves as follows:

.1 In poured concrete slabs, unless otherwise specified in the Contract Documents: Provide "Pipe Sleeves (Floors/Slab-on-Grade)"

.2 In above grade exterior concrete, masonry, or aluminum panel walls: Provide "Waterproof Pipe Sleeves (Above Grade Walls)"

.3 In above grade interior concrete/masonry walls: Provide "Non-Waterproof Pipe Sleeves (Above Grade Walls)"

.4 In concrete foundation walls not entering an interior space: Provide "Non-Waterproof Pipe Sleeves (Below Grade Walls)".

.5 In below grade exterior walls: Provide “Waterproof Pipe Sleeves (Below Grade Walls).

.2 Sleeves in waterproofed slabs shall be lengths of mild galvanized steel pipe in accordance with the Drawing detail. Provide waterproof Pipe Sleeves (Floors/Slab-on-Grade) in the following locations:

.1 In mechanical room floor slabs, except where on grade.

.2 In slabs over mechanical, fan, electrical and telephone equipment rooms or closets.

.3 In all floors equipped with waterproof membranes.

.4 In the roof.

.3 Size above grade sleeves, unless otherwise specified in the Contract Documents, to leave 12 mm (½") clearance around the pipes, or where pipe is insulated, a 12 mm (½") clearance around the pipe insulation/jacket. The clearance noted above is nominal based on available pipe sizes.

.4 Size below grade sleeves, unless otherwise specified in the Contract Documents, to leave a 25 mm (1") clearance around the pipes, or where pipe is insulated, a 25 mm (1") clearance around the pipe insulation/jacket. If required clearance shall be increased to 50mm (2”) as required to account for sloping, etc. The clearance noted above is nominal based on available pipe sizes.

.5 Pack and seal the void between the pipe sleeves and the pipe or pipe insulation for the length of the sleeves as follows:

.1 Pack sleeves in fire rated construction as specified in the article entitled "INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS". Sleeves in fire rated construction will be packed and sealed as part of the work of Division 7.

.2 Pack sleeves in non-fire rated interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound.

.3 Pack sleeves in exterior walls, above grade, with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound for exterior applications. Colour of caulking compound shall be selected to match the exterior wall finish as closely as possible.

.4 Pack sleeves in exterior walls, below grade, with non-crosslinked polyethylene foam. Hold the non-crosslinked polyethylene foam in place with stainless steel bands. If below grade sleeve needs to be watertight (or any other above grade sleeve where water leakage has been determined to be a problem during commissioning/wall leakage tests) use a link seal type mechanical seals as specified in this section in place of packing material.

.6 Where sleeves are required in masonry work, accurately locate and mark the sleeve position, and turn the sleeves over to the trade performing the masonry work for installation.

.7 Terminate sleeves for piping which will be exposed so that the sleeve is flush at both ends with the wall, partition or slab surface so that the sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to extend 100 mm (4") above the finished surface.

.8 "Gang" type sleeving will not be permitted.

.9 Where sleeves are provided for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of the sleeved opening.

3.2 INSTALLATION OF WATERPROOFING SEAL MATERIALS

.1 Provide watertight link type mechanical seals in exterior wall openings where shown and/or specified on the Drawings.

.2 Assemble and install each mechanical seal in accordance with the manufacturer's instructions.

.3 Periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until the seal is completely watertight.

3.3 DUCT OPENINGS

.1 Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in poured concrete work, masonry, drywall and other building surfaces by the trade responsible for the particular construction in which the opening is required.

.2 Ensure that openings for fire dampers up to 600 mm (24") high are sized to suit the damper arrangement with the folding blade out of the air stream.

3.4 SLEEVE AND FORMED OPENING LOCATION DRAWINGS

.1 Prepare and submit for review and forwarding to the concrete reinforcement detailer, drawings indicating all required sleeves, recesses and formed openings in poured concrete work. Such drawings shall be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum.

.2 Begin to prepare such drawings immediately upon notification of acceptance of Tender and award of Contract.

3.5 INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIAL

.1 Where mechanical Work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal material installed in accordance with the ULC Firestop System requirements to seal holes and voids in the walls or slabs, as follows:

.1 Bare pipe or conduit through a floor with a circular sleeved or core drilled opening - ULC System SP115.

.2 Bare pipe or conduit through a floor with a rectangular cast or cut opening - ULC System SP116.

.3 Bare pipe or conduit through a wall with a circular sleeved or core drilled opening - ULC System SP114.

.4 Bare pipe or conduit through a wall with a rectangular cast or cut opening -ULC System SP107.

.5 Insulated pipe through a wall with a sleeved or core drilled circular opening - ULC System SP108.

.6 Insulated pipe through a wall with a rectangular cast or cut opening - ULC System SP107.

.7 Insulated pipe through a floor with a circular sleeved or core drilled opening - ULC System SP109.

.8 Insulated pipe through a floor with a rectangular cast or cut opening - ULC System SP116.

.2 Note that the insulation for insulated piping penetrating fire rated construction is specified in Section 20 07 00 and is fire rated insulation with a vapour barrier jacket, ULC listed as a firestop component for use with ULC Systems SP107, SP108, SP109, and SP116.

.3 At all fusible link damper locations in ductwork penetrating fire rated construction, seal the perimeter of the angle iron framing on both sides of the wall or slab with ULC listed and labelled sealant materials to provide a positive smoke seal.

3.6 INSTALLATION OF PIPE ESCUTCHEON PLATES

.1 Provide escutcheon plates secured over all exposed piping passing through finished areas.

.2 Install the plates so that they are tight against the building surface and associated pipe/pipe insulation jacket and ensure that the plates completely cover pipe sleeves and/or openings, except where waterproof sleeves extend above floors.

3.7 INSTALLATION OF FASTENING AND SECURING HARDWARE

.1 Provide all fastening and securing hardware required for mechanical Work to maintain installations attached to the structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed products.

.2 Use fasteners compatible with the structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.

.3 Where the floor, wall or ceiling construction is not suitable to support the loads, provide additional framing or special fasteners to ensure proper securement to the structure that is to support the products. Provide reinforcing or connecting supports where required to distribute the loading to the structural components.

.4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with the requirements of CSA Standards CAN3-Z166.1 and 2-M85.

3.8 INSTALLATION OF EQUIPMENT DRIVE GUARDS AND ACCESSORIES

.1 Protect all exposed accessible rotating parts on all mechanical equipment with a guard.

.2 Secure guards to the equipment or equipment base but do not bridge sound or vibration isolation.

3.9 PIPE LEAKAGE TESTING:

.1 General: Before new piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test all piping for leakage. Where tests are to be witnessed, arrange for the appropriate people to be present. Securely close all openings and pipe ends prior to test. If pressure cannot be maintained during an air test, test all piping joints with a water-soap solution while the piping is under pressure to detect leaks. Once the test has been complete clean and flush the piping in accordance with Section 20 11 16 – “Cleaning and Filling”. Fix all leaks that occur during or after the testing period once the piping system has been filled.

.2 Drainage & Vent Piping: Perform a water and/or air pressure test in accordance with local plumbing code. After the fixtures and fittings are set and the pipes connected to the building drain or drains, turn on water into all pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Make a smoke test and/or ball test if required by local plumbing code.

.3 Forced Sanitary and Storm Drainage lines: Test piping with cold water and/or air in accordance with local plumbing code and at a minimum pressure of 1-1/2 times normal working pressure. Maintain the pressure for a minimum of two hours.

.4 Potable Water Piping: Test piping with cold water and/or air in accordance with local plumbing code and at a minimum pressure of 1-1/2 times normal working pressure. Maintain the pressure for a minimum of two hours.

.5 Sprinkler System Piping: Test all system piping with cold water in accordance with requirements of NFPA No. 13, "INSTALLATION OF SPRINKLER SYSTEMS", and in accordance with any additional requirements of governing authorities.

.6 Standpipe System Piping: Test all system piping with cold water in accordance with requirements of NFPA No. 14, "STANDPIPE AND HOSE SYSTEMS", and in accordance with any additional requirements of governing authorities.

.7 Heat Transfer System Piping: Test piping with cold water and/or air at a pressure of 1035 kPa (150 psi) for a minimum of two hours.

.8 Steam & Condensate Piping (Humidifier): Test piping with cold water and/or air for a minimum of two hours at the following pressures:

.1 0 kPa (0 psi) to 105 kPa (15 psi) low pressure piping - 690 kPa (100 psi)

.2 110 kPa (16 psi) to 690 kPa (100 psi) medium pressure piping - 1035 kPa (150 psi)

.3 690 kPa (100 psi) and greater high pressure piping - 1380 kPa (200 psi)

.9 Natural Gas Piping: Test piping in accordance with the requirements of CAN 1- B149.1. After completion of the verification test, locate the required tag stating the results of the verification test at the point of entry of the gas main into the building, affixed to the pipe in a secure manner. Check all piping joints and connections for leaks with a water/soap solution while the piping is under pressure.

.10 Compressed Air Piping: Test piping with dry compressed air at the system operating pressure or a minimum of 690 kPa (100 psi) for a minimum of two hours.

.11 Fuel Oil Piping: Test piping (not tanks) with dry compressed air for a minimum period of two hours at 1035 kPa (150 psi). Check all piping joints and connections for leaks with a water/soap solution while the piping is under pressure.

.12 Refrigerant Piping: Test refrigerant piping for leakage and dehydrate in accordance with requirements of the 2010 ASHRAE HANDBOOK - REFRIGERATION.

.13 Temporarily remove or valve off all piping system specialties or equipment which may be damaged by test pressures prior to pressure testing the systems, and flush piping to remove foreign matter.

.14 When testing is carried out below the highest level of the particular system, increase the test pressure by the hydrostatic head (7 kPa (1 psi) for every 600 mm (24 inches) below the high point).

.15 Include for temporary piping connections required to properly complete the tests.

.16 Make tight leaks found during tests while the piping is under pressure, and if this is impossible, remove and refit the piping and reapply the test until satisfactory results are obtained.

.17 Where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions.

.18 Tests may be done in sections, as later approved.

.19 In addition to the leakage tests specified above, demonstrate proper flow throughout the systems including mains, connections and equipment, as well as proper venting and drainage. Include for any necessary system adjustments to achieve the proper conditions.

3.10 INTERRUPTIONS TO AND SHUT-DOWNS OF MECHANICAL SERVICES AND SYSTEMS

.1 Co-ordinate all shut-downs and interruptions to the existing mechanical systems with section 01 14 00 - Work Restrictions.

.2 Upon award of the contract, submit a list of anticipated shut-down times and their maximum duration.

.3 Prior to each shut-down or interruption, inform the Construction Contractor in writing 72 hours in advance of the proposed shut-down or interruption and obtain written approval from the Construction Contractor to proceed. Do not shut-down or interrupt any system or service without such written approval.

.4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible. Prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.

3.11 EQUIPMENT BASES AND SUPPORT

.1 Unless otherwise specified in the Contract Documents, set all floor mounted equipment on 100 mm (4") high concrete housekeeping pads 150 mm (6") wider and longer than the equipment base dimensions and/or wider according to seismic restraints requirements.

.2 Supply dimensioned drawings, equipment base templates and anchor bolts for proper setting and securing of equipment on pads, and be responsible for all required leveling, alignment, and grouting of the equipment.

.3 For equipment not designed for base mounting, where required, provide prime coat painted structural steel stands flange bolted to housekeeping pads.

.4 Provide prime coat painted structural black steel angle or channel frames and brackets for all surface wall mounted equipment not specifically designed for surface wall mounting, unless otherwise specified in the Contract Documents.

3.12 EXCAVATION AND BACKFILL WORK

.1 Excavation, backfill and related Work such as dewatering required for the mechanical Work shall be performed as part of the Work of Division 31, except for final hand grading Work which is to be performed as part of the Work of Division 23.

.2 Inverts and locations of existing site services have been shown on the Drawings. The inverts and locations shown are approximate, and it is contractor's responsibility to confirm and verify the exact inverts and locations prior to commencing work.

.3 Accurately mark-out the location and routing of excavation required for the work of this Section, as well as the required depth.

.4 Ensure that all underground piping subject to freezing and located outside the building has a minimum of 2 to 2.4 m of cover. Refer to Winnipeg by-laws and Civil Drawings.

.5 Ensure that all underground piping subject to freezing and located inside the building in unheated areas has a minimum of 450 mm of cover.

.6 Protection: Provide protection to existing structures and services. Be responsible for rectifying any damage to existing structures and services resulting from this operation.

.7 Excavation in Soil:

.1 Where rough excavation is carried out by Division 31, perform all layout work for trenches required under this Division, including verification of trench depths and slopes. Work in close cooperation with excavating trades that remove subgrade to within 6 in. (150 mm) of the correct and final trench depth

.2 Perform the final excavation to the correct trench invert to permit proper bedding. Excavation carried below the correct inverts shall be backfilled with 2000 psi (13.5 mPa) concrete to the underside of the pipe lines, unless otherwise directed in writing.

.8 Ensure that pipe bedding is proper prior to laying pipes. Hand excavate under pipe hubs, couplings, flanges and similar items to ensure even bearing along the entire barrel of each length of pipe.

.9 Ensure that piping is inspected, leakage tested and approved prior to backfilling. Supervise the initial backfilling operation to ensure that the buried Work is not disturbed.

.10 Backfill pipe trenches with sand to a depth 300 mm (12 in.) above the pipe. The sand shall be thoroughly tamped around and over the pipes in 150 mm (6 in.) layers.

.11 Ensure that all piping under the building footing is protected and encased in concrete and within an additional protective sleeve. Refer to structural for concrete encased piping details.

3.13 PACKING AND SEALING CORE DRILLED PIPE OPENINGS

.1 Pack and seal the void between the pipe opening and the pipe or pipe insulation for the length of the opening as follows:

.1 Pack openings in non-fire rated interior construction with mineral wool and seal both ends of the opening with non-hardening silicone base caulking compound to produce a water-tight seal.

.2 Pack and seal openings in fire rated walls and slabs as specified in this Section.

.3 Pack and seal openings in exterior walls with mechanical link type waterproofing seal materials specified in PART 2 of this Section.

3.14 HOISTS AND SCAFFOLDS

.1 Provide interior movable or roller scaffolds for the installation of the mechanical work.

3.15 ACCESS OF EQUIPMENT

.1 Make all arrangements to ensure that access into the building is available for all Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems Divisions equipment. Do all hoisting and rigging into place of all specified equipment and be responsible for any damages incurred.

3.16 EQUIPMENT PROTECTION AND CLEAN-UP

.1 Protect equipment and material in storage on site and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Operate, drain and flush out bearings and refill with new change of oil, before final acceptance.

.4 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign material.

.5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

3.17 TEMPORARY OR TRIAL USAGE

.1 Temporary or trial usage by the City of mechanical equipment supplied under contract shall not represent acceptance.

.2 Repair or replace permanent equipment used temporarily.

.3 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

3.18 SEMI-FINAL AND FINAL INSPECTIONS

.1 Refer to Section 01 77 19 – Closeout Procedures, and the following.

.2 Perform the following items prior to semi-final inspection:

.1 Make heating, ventilation and air conditioning systems capable of operation with automatic controls in operation generally, but not necessarily finally calibrated.

.2 Make necessary tests on equipment including those required by authorities having jurisdiction. Obtain certificates of approval.

.3 Rough balance air systems.

.4 Completely identify equipment so as to be clearly visible.

.5 Lubricate equipment as per manufacturer's data.

.6 Review and ensure access doors are suitably located and of correct type and equipment is easily accessible including plumbing cleanouts.

.7 Clean fan plenums, remove temporary filters and install permanent filters.

.8 Check operations of plumbing systems and fixtures and ensure fixtures are solidly supported.

.3 Prior to semi-final inspection, provide complete list of items which are deficient at the time of the semi-final inspection.

.4 Provide declaration in writing that deficiencies noted at time of semi-final inspection have been corrected and the following items completed prior to the final inspection:

.1 Clean equipment both inside and out and lubricate.

.2 Clean plumbing fixtures and brass.

.3 Complete final balancing.

.4 Submit rough data of balance reports.

.5 Complete final calibration.

3.19 SUBSTANTIAL COMPLETION INSPECTION

.1 Refer to Section 01 77 19 – Closeout Procedures, and the following.

.2 Prior to the Construction Contractor requesting an inspection for substantial completion all the following items must be provided to permit beneficial use by the City.

.1 Maintenance and Operating Manuals to be submitted and approved.

.2 As built drawings.

.3 Air and hydronic balancing TAB reports.

.4 All motor name plate ratings and actual operating amps and voltages.

.5 All systems shall be certified in writing by the Construction Contractor as complete and fully operational.

.6 Instructions to the City's operating personnel shall be provided in accordance with the specifications. A signed statement to this effect, countersigned by the City, shall be submitted to the Contract Administrator.

.7 A complete list of items which the Construction Contractor has not finished, or are deficient shall be provided. If, in the opinion of the Contract Administrator, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.

.8 The Construction Contractor shall be fully responsible to accumulate all necessary data from this Contractor and suppliers and present same in the specified format for the approval by the Contract Administrator.

3.20 INSTRUCTIONS TO CITY

.1 Instruct the City's designated representatives in all aspects of the operation and maintenance of systems and equipment specified in this Division.

.2 Arrange and pay for the services at the site of qualified technicians and other manufacturer's representatives to instruct on specialized portions of the installation.

.3 Submit, prior to issue of a Certificate of Substantial Performance, a complete list of systems for which instructions where given to the City, stating for each system:

.1 Date instructions were given to the City's staff;

.2 Duration of instruction;

.3 Names of persons instructed;

.4 Other parties present (manufacturer's representatives, etc.).

.4 Obtain the signatures of the City's staff to verify that they properly understood the system installation, operation and maintenance requirements and have received operating and maintenance manuals and record Drawings.

3.21 COMMON MOTOR REQUIREMENTS

.1 Manufacturer’s Instructions:

.1 Compliance: comply with Manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.2 Installation of Equipment Drive Guards and Accessories:

.1 Protect all exposed accessible rotating parts on all mechanical equipment with a guard.

.2 Secure guards to the equipment or equipment base but do not bridge sound or vibration isolation.

3.22 FIELD PAINTING

.1 After equipment has been installed and prime painted piping and installation is completed, clean rust and oil from exposed iron and steel work under this Division, whether or not it has been factory prime painted.

.2 In all building areas touch up any damage to prime coat resulting from shipping or installation and leave ready for final painting under Finishes.

.3 In areas such as mechanical/ industrial process/ electrical equipment rooms, boiler rooms, service spaces and fan rooms …etc.:

.1 Paint exposed galvanized metal surfaces with one coat of zinc dust galvanized primer and one coat of 100% Alkyd base enamel in an approved colour.

.2 Paint exposed iron or steel work with one coat of chrome oxide phenolic base primer and one coat of 100% Alkyd base enamel in an approved colour.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements

1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B40.3, Bimetallic Actuated Thermometers.

.2 ASME B40.100, Pressure Gauges and Gauge Attachments.

.2 National Building Code 2020 (NBC)

1.3 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Shop Drawings: Submit manufacturer product literature of all equipment in this section; include working ranges of thermometers and gauges.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 PIPELINE PRESSURE GAUGES

.1 Pressure Gauges: Round, 100 mm or 115 mm (4" or 4 ½") diameter, adjustable (90°) angle bimetal dial type, glycerine filled, each accurate to within 1% of scale range and complete with:

.1 Dust-tight, stainless steel (type 304) case with relief valve and polished stainless steel steam, stainless steel rotary geared movement, with stainless steel bushings and socket.

.2 Clear acrylic window, black pointer, with white face, and black lettering.

.3 Dual scale (psi and kPa) with a scale range to cover twice the average working pressure of the equipment and shall be compound gauges on pump suction for all open systems.

.4 Provincial Boiler and Pressure Vessel Safety Branches registration number.

.2 Pressure Gauge Accessories & Additional Requirements:

.1 Each pressure gauge shall be equipped with a bronze ball valve.

.2 Each pressure gauge for piping and equipment with normal everyday flow shall be equipped with a brass pressure snubber.

.3 When the equipment is subject to vibration, mount the gauge on adjacent wall or on a mounting plate, supported from the floor.

.3 Acceptable manufacturers:

.1 H. O. Trerice Co. No. 700 Series.

.2 Weiss Instruments Inc., Model LF402.

.3 Ashcroft Inc., #35-1009-SWL.

.4 Winters Instruments Inc. Model PFP.

2.2 MANOMETERS

.1 Manometers: Magnehelic gauge type, Round, 100 mm or 115 mm (4" or 4 ½") diameter, each accurate to within 2% of scale range and complete with:

.1 Dust-tight aluminium case, clear acrylic window, black pointer, with white face, and black lettering.

.2 Gauge range shall be 2½ times the maximum filter resistance. Case shall be suitable for duct or plenum mounting.

.3 Dual scale (psi and kPa) with a scale range of 0 to 0.5 kPa (0 to 2 in.) with 0.005 kPa (0.02 in.) graduations in both metric and imperial scales.

.4 Provide bracket for mounting gauge on insulated ducts or plenums.

.5 Two 1500 mm (60 in.) lengths of tubing.

.2 Acceptable manufacturers:

.1 Dwyer Series 2000 Magnehelic.

2.3 PIPELINE THERMOMETERS

.1 Thermometers: Round, 125 mm (5") diameter, adjustable (90°) angle bimetal dial type, each accurate to within 1% of full scale and complete with:

.1 Dust-tight, hermetically sealed stainless steel case with stainless steel ring, dampened bimetal coil, calibration adjustment screw, 12 mm (½") NPT connection, 6.4 mm (¼") diameter stainless steel stem, and a suitable thermowell.

.2 Clear acrylic window, black pointer, with white face, and black lettering.

.3 Dual scale (Fahrenheit and Celsius), scale range shall typically be from 0 to 115 deg. C. (32 to 240 deg. F.) for hot water and -17 to 49 deg. C. (0 to 120 deg. F.) for chilled water. For fluids outside of typical operating conditions the scale shall range such that the working temperature of the system is the approximate mid-point of the scale.

.4 Temperature marking in 1 deg. C. (2 deg. F.) increments in both imperial and metric scales.

.5 Thermowells shall be registered with the Provincial Boiler and Pressure Vessel Safety Branch and have a C.R.N. registration number.

.2 Acceptable manufacturers:

.1 H.O. Trerice Co. Model B856.

.2 Weiss Instruments Inc., Model 5VBM.

.3 Ashcroft Inc., #50EI Series.

.4 Winters Instruments Inc., Model TBM.

2.4 DUCT THERMOMETERS

.1 For ducts with the largest dimension up to 750 mm (30 in.) thermometers shall be similar to pipeline thermometers but with an additional perforated bulb guard and shall be flanged for mounting on ducts.

.2 For ducts over 750 mm (30 in.) in largest dimension thermometer: Round, 115 mm (4½ in.) diameter, each accurate to within 1% of full scale and complete with:

.1 Dust-tight, cast aluminum case, vapour filled, 1500 mm (60 in.) minimum length copper averaging bulb with bronze braided armour.

.2 Clear acrylic window, black pointer, with white face, and black lettering.

.3 Range normally 0 to 115 deg. C. (32 to 240 deg. F.) for heated supply air, 0 to 80 deg. C. (32 to 175 deg. F.) for cooled supply, mixed and return air and –40 to 90 deg. C. (–40 to 195 deg. F.) for outside air but range shall suit maximum and minimum temperature of location and shall be shown on Shop Drawings.

.4 Temperature marking in 1 deg. C. (2 deg. F.) increments in both imperial and metric scales.

.5 Flanged for mounting on ducts.

.6 For insulated ducts or plenums provide a bracket for mounting thermometer clear of insulation.

.7 Acceptable manufacturers:

.1 H.O. Trerice Co., Model 80445.

.2 Weiss Instruments Inc., Model 45VA3

.3 Thermometers for remote reading shall be similar to duct thermometers specified above but with armoured extension capillary and bulb with separable well for pipelines or flanged duct connection for averaging bulb, as required.

3 Execution

3.1 GENERAL INSTALLATION OF METERS OF GAUGES

.1 Locate, mount, and adjust all thermometers and pressure gauges so they are easily readable from the floor or platform.

.2 Where pressure gauges and/or thermometers are located at high level or in an area where they cannot be easily seen, provide remote reading gauges and/or thermometers.

.3 Locate remote instruments next to the point of the reading, on wall or structure.

.4 Each remote or panel mounted instrument shall have an engraved lamacoid nameplate identifying the system and service.

3.2 INSTALLATION OF PRESSURE GAUGES

.1 Insert pressure gauges into equipment tappings or in pipelines using screwed tees or forged steel couplings welded into the lines.

.2 For pressure gauges in piping at equipment locations, install the pressure gauge between the equipment and the first pipe fitting.

.3 Pressure gauge piping shall be of the same material as the pipe it is attached to.

.4 Provide pipeline pressure gauges in the following locations:

.1 City water line where it enters the building.

.2 Outlet of the building backflow preventer assembly.

.3 Inlet and outlet of all individual backflow preventers distributed throughout the facility.

.4 Inlet and outlet of each water softener assembly, if provided

.5 Inlet and outlet of all pressure reducing valves,

.6 Inlet and outlet of all domestic water booster pumps,

.7 Inlet of each hydronic loop make-up water line.

.8 In valved tubing across the suction, suction strainer (if applicable), and discharge piping of each circulating pump.

.9 In the supply and return piping of each heat exchanger, condenser, cooler or other type of equipment.

.10 In expansion piping to expansion tank(s).

.11 In separate domestic hot water storage tank(s).

.12 Wherever else shown and/or specified on the Drawings or in the Specification.

.5 Provide duct pressure gauges in the following locations:

.1 Install manometer at each bank of filters to show the resistance to air flow through the filters. Where prefilters and final filters are mounted in a common frame it is only necessary to provide a single manometer to show the resistance across the total filter assembly. Where filters are separately mounted in individual frames provide a manometer for each set of filters.

3.3 INSTALLATION OF THERMOMETERS

.1 Insert pipeline thermometer into tanks, equipment tappings or in pipeline using screwed tees or forged steel couplings, welded into the lines.

.2 Duct thermometers shall be attached to duct using sheet metal screws through thermometer flange.

.3 Provide pipeline thermometers (angle type or straight type (as required)) in the following locations:

.1 In and out of each water coil or other coil, handling liquid, except individual reheat coils in ductwork.

.2 On each branch of 3 port control valves, excluding valves on fan coil, or individual reheat coils in ductwork.

.3 In the supply and return piping of each heat exchanger, condenser, cooler, hot or cold water storage tank, or other type of equipment.

.4 Each heating/chilled water return and each heating/chilled water supply for each main system.

.5 Wherever else shown and/or specified herein or on the Drawings

.4 Provide duct thermometers at the following locations in ducts or plenums:

.1 Upstream and downstream from each coil, spray or humidifier, except individual reheat coils in ductwork.

.2 On each of 3 ducts or plenums at mixing dampers.

.3 Return air from each zone.

.4 Outside air entering air handling units.

.5 Wherever else shown and/or specified on the Drawings or in the Specification.

.5 When a common supply header provides the same temperature water to many coils or to many zones, provide a thermometer on the common header only, rather than a thermometer on each branch.

.6 Where a common duct or plenum provides the same temperature air to many zones, provide a thermometer on the common duct only, rather than at each branch of a zone.

.7 Provide thermowells for thermometers where shown. Thermowells shall be compatible with the thermometers used. Provide a coat of metallic base heat transfer paste or grease in the piping well.

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section covers the work of designing, fabrication and installation of pipe support systems for process and building mechanical piping systems unless the pipe support has been detailed elsewhere in the Contract Documents.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 20 05 48 – Vibration Isolation.

.3 Section 20 05 50 – Seismic Restraint Systems.

.4 Section 20 07 00 – Mechanical Insulation

.5 Section 22 11 19 – Domestic Water Piping Specialties.

.6 Section 22 11 20 – Domestic Water Expansion Tanks.

.7 Section 23 30 00 – HVAC Ducts and Plenums.

.8 Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems Divisions

1.3 REFERENCE STANDARDS

.1 The American Society of Mechanical Engineers (ASME)

.1 ASME B31.1, Power Piping.

.2 ASME B31.9, Building Services Piping.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A123/A123M, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.

.3 Canadian Standards Association (CSA)

.1 CSA B214, Installation Code for Hydronic Heating Systems.

.4 Manufacturers Standardization Society

.1 ANSI/MSS SP-58, Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Applications and Installation.

.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 ANSI/SMACNA 006, HVAC Duct Construction Standards - Metal and Flexible

.6 National Building Code of Canada 2020

.7 National Plumbing Code of Canada 2020

1.4 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings:

.1 The Contractor and/or Vendor shall submit shop drawings and calculations of estimated loads/forces, showing the recommended location and type for all pipe anchors and pipe guides according to Contractor's pipe layout for all systems with the potential for thermal expansion/contraction and/or loads due to weight or thrust. The submittal will be reviewed by Structural Division to advise if any additional structural reinforcement/ bracing is required to be provided, prior to installation.

.2 The drawings shall include all details of construction, static and dynamic forces at points of attachment, etc. necessary for review and acceptance by the Contract Administrator. Make adjustments as necessary to satisfy the requirements of the Structural Division. At the request of the Contract Administrator, the Contractor shall participate in workshops to confirm piping materials and hanger strategy, per building or building section.

.3 The drawings shall identify each pipe support, hanger, pipe guide, and pipe anchor type by catalogue number and Shop Drawing detail number. No pipe anchor points shall be permitted without reviewed shop drawings and, where installed prior to review, shall be removed and replaced to the satisfaction of the Contract Administrator.

.4 If additional structural reinforcement/bracing is required as noted in clause 1 and 2 above, provide suggested installation drawings, catalogue information, and complete component specifications, for review by Structural Division.

.5 Pipe, ductwork, equipment, electrical conduits, control equipment and panels (Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems and equipment Divisions)…etc, supports and anchorage designed to the requirements of a post-disaster facility, as applicable, shall require additional submittals as listed in Section 20 05 50– Seismic Restraint System.

.6 Minor pipe layout changes are permitted to take place in the field, provided that the changes are communicated to the Contract Administrator for review and approval.

.3 Information Submittals: Maintenance information on the piping support system.

1.5 DESIGN REQUIREMENTS

.1 General:

.1 Piping, ductwork and equipment provided under the Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems and equipment Divisionsshall be complete with all necessary supports and hangers required for a safe and workmanlike installation.

.2 Hangers, supports, anchors, guides, and restraints shall be selected to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment.

.3 Select and provide pipe supports and anchorage for vertical and lateral loading in accordance with the National Building Code for post-disaster structures, as applicable. See Section 20 05 50 – Seismic Restraint System for further requirements, as applicable.

.4 The Contractor shall select, provide, and space the hangers/supports while considering the following factors in order to prevent swaying, buckling, and to control the effects of thrust:

.1 Pipe weight (wall thickness/pipe schedule).

.2 Configuration (additional requirements for supports at or near every change of direction, take off, etc.).

.3 Additional weight (load) of insulation (type and thickness).

.4 Additional supports for valves, circulators, meters, instruments, and other equipment.

.5 Pipe contents (water, glycol, air, etc.).

.6 Pipe expansion/contraction.

.7 Operating temperature (increased sagging/deflection at high temperatures).

.8 Limitation of structural attachments to pipe supports.

.9 Criticality of system (potential extent of damage to the building and occupants).

.10 Vibration (pulsating systems require additional support to minimize natural frequency of piping system).

.5 Any modification to the piping layout, including the addition of flexible joints where not shown on the Contract Drawings, shall require the review and approval by the Contract Administrator.

.1 Minor piping layout changes are permitted to take place in the field and be properly documented. Additional hangers/support to accommodate the modified piping layout shall be selected and provided by the contractor.

.6 Piping shall not be anchored rigidly to a support, with the exception of pipe anchors in a designated expansion loop/section, but shall be allowed the freedom of movement to allow for expansion and contraction according to pipe material and size limitations.

.2 Pipe Support Systems:

.1 Select and provide pipe support system within the spans and component requirements specified in the Contract Documents.

.2 Generally, the piping supports specified to be selected, supplied and installed by the Contractor are not shown on the Contract Drawings. The absence of pipe supports and details on the Contract Drawings shall not relieve the Contractor of its responsibility for sizing and providing supports.

.3 Criteria for Structural Design and Selection of Pipe Support System Components:

.1 Dead loads imposed by the weight of the pipes filled with water, except air and gas pipes within the specified spans and component requirements, plus any insulation.

.2 Design for seismic loads, as applicable, as referenced in item 1.5.1.3 of this Section.

.3 Safety Factor for drilled-in Concrete Anchors (for example, Hilti type anchors): Minimum of 5.

.4 Select, size, and provide pipe support structural attachments, including lateral supports, concrete anchor bolts, concrete inserts, beam clamps, and other devices used to attach the pipe support to the building structure. Attachments shall be selected to withstand the shear and pullout loads imposed by loading and spacing on each particular pipe support.

.5 Steel Framing Support System:

.1 Bending Members: Are to be sized such that beam stress does not exceed allowable stresses in accordance with the requirements of the NBC and maximum deflection does not exceed 1/240 of span.

.2 Compression Members: Size in accordance with the manufacturer's recommended method.

.3 Support Loads: Calculate using weight of pipes filled with water or glycol (as applicable).

.3 Pipe Support Spacing:

.1 Vertical Supports:

.1 Space supports as required to satisfy the requirements in the applicable codes, reference standards, manufacturer recommendations, and good industry practice considering all factors outlined in Article 1.5.A of this specification section.

.2 Note that this spacing may require the use of higher load pipe clamps and more than a single point anchor point in concrete.

.2 Horizontal Supports:

.1 Space supports as required to satisfy the requirements in the applicable codes, reference standards, manufacturer recommendations, and good industry practice considering all factors outlined in Article 1.5.A of this specification section.

.2 Support pipe at changes in direction or elevation and adjacent to flexible joints, couplings, fittings, and valves within 610mm (24 in.) on each side on pipes over 40mm (1½ in.) diameter.

.3 Lateral Supports:

.1 Tie-rods in two directions or combined tension/compression members.

.4 Plastic and Fibreglass Piping:

.1 Space supports as required to satisfy the requirements in the applicable codes, reference standards, and good industry practice considering all factors outlined in Article 1.5.A of this specification section.

.2 As recommended by the manufacturer for the operating temperature in pipe.

.5 Pipe Support Hanger Rods:

.1 Galvanized steel (unless otherwise specified in the Contract Documents, refer to clause 2.1-C), round, threaded, to ASTM A36, complete with captive machine nuts with washers at hangers.

.2 Sized to suit the loading conditions in accordance with applicable codes, reference standards, manufacturer recommendations, and good industry practice considering all factors outlined in Article 1.5.A of this specification section.

.3 When supporting multiple pipe runs rod size to be in accordance with the Contractor's Professional Engineer design.

.6 Thrust Restraint:

.1 Thrust Blocks and Ties: For specified piping systems, thrust blocks, and ties at pipe joints, which are unable to transmit thrust forces, may be shown on the Contract Drawings.

.2 If requested by the Contract Administrator, Contractor's piping layout/system shall be analyzed by a thrust restraint Vendor, engaged by and paid by the Contractor. Such piping systems shall be provided with thrust blocks, ties and/or other restraint systems as required to resist all internal and external forces on the piping system. The Vendor's recommendations shall be provided as part of the shop drawing submittal process and provide information on lateral deflection, axial strain and any resulting unbalanced forces on equipment or connecting piping systems.

.4 Duct Support Spacing:

.1 Unless otherwise specified or shown maximum duct support spacing and hanger construction shall be in accordance with Chapter 5 of SMACNA or the table below:

Table 1: Maximum Horizontal Duct Hanger Spacing

Duct Dimension	Hanger Construction
Horizontal rectangular duct	
Up to 1500 mm (60 in.) for Low Pressure Ductwork Only	Two 25 mm (1 in.) x 16 US gauge straps with two screws on side of duct one screw on bottom. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
For all sizes of Medium and High Pressure Ductwork up to 3000 mm (120 in.) and Low Pressure Ductwork from 1525 mm to 3000 mm (61 in. to 120 in.)	50 mm x 50 mm x 6 mm (2 in. x 2 in. x 1/4 in.) trapeze hanger with two 9 mm (3/8 in.) dia. rods. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
3000 mm to 6000 mm (120 in. to 240 in.)	65 mm x 65 mm x 5 mm (2-1/2 in. x 2-1/2 in. x 3/16 in.) trapeze hanger with two 9 mm (3/8 in.) dia. rods. Hangers shall be at each joint but in no case more than a maximum 1200 mm (48 in.) on centres.
Horizontal round duct	
Up to 450 mm (18 in.)	One 25 mm (1 in.) x 16 US gauge hanger ring supported from one 25 mm (1 in.) x 16 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
475 mm to 900 mm (19 in. to 36 in.)	One 25 mm (1 in.) x 12 US gauge hanger ring supported from 25 mm (1 in.) x 12 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
925 mm to 1250 mm (37 in. to 50 in.)	One 25 mm (1 in.) x 12 US gauge hanger ring supported from 25 mm (1 in.) x 12 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
1275 mm to 2100 mm (51 in. to 84 in.)	Two 40 mm (1-1/2 in.) x 12 US gauge hanger connected to the 32 mm x 32 mm x 3 mm (1-1/4 in. x 1-1/4 in. x 1/8 in.) angle girth reinforcing of duct hanger. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.

.1 Support all vertical ducts at each floor, on all sides, with angle riveted to the ducts.

.2 Support all horizontal ducts within 610mm (24 in.) of each elbow and within 1200mm (48in.) of each branch intersection.

.3 Flexible duct lengths greater than 2,400 mm (84 in.) shall be supported at the midpoint with strap hangers.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 GENERAL

.1 Pipe hanger and support materials, including accessories, shall be, unless otherwise specified in the Contract Documents, constructed in accordance with the MSS Standard Practice Manual SP-58, “Pipe Hangers and Supports – Materials, Design and Manufacture”, and, where possible, MSS designations are indicted with each product.

.2 Ductwork hanger and support materials, including accessories, shall be, unless otherwise specified in the Contract Documents, constructed in accordance with the SMACNA, “HVAC Duct Construction Standards”.

.3 All pipe hangers, equipment and exposed ductwork hangers shall be zinc plated unless otherwise noted. All hangers located or exposed to the environment or located indoors in potential high humidity areas, water spray areas, or corrosive areas, such as bus wash areas, undercarriage bus wash area, bus wrap areas, power wash areas (multiple locations), steam bay areas, shall be constructed from corrosion resistant materials e.g. Stainless Steel 316 or fiberglass. Submit shop drawings and layouts depicting the various hangers’ materials.

.4 Hangers and supports for insulated piping and ductwork shall be sized to fit around the insulation and covering (not through insulation).

.5 All pipe hangers and supports shall be manufactured to the latest requirements of MSS-SP-58. Where applicable, design and manufacture of hangers and supports shall also conform to ANSI/ASME Code for Pressure Piping B31.1

.6 When specified proprietary pipe support items are not available, fabricate pipe supports of the specified material and to the general configuration indicated by the Contract Drawings.

.7 Special support and hanger details as designed by the Contractor’ Professional Engineer may be used for cases where standard catalogue supports are inapplicable or unpractical.

2.2 HORIZONTAL SUSPENDED PIPING

.1 Adjustable Clevis Type: MSS SP 58, Type 1.

.1 Anvil International Inc.; Fig. 260

.2 Cooper B Line Inc.; Fig. B3102

.3 Taylor/Walraven; #24

.2 Adjustable Split Ring Pipe Clamp: MSS SP 58, Type 6 or 12.

.1 Anvil International Inc.; Fig. 104

.2 Cooper B Line Inc.; Fig. B3198H

.3 Taylor/Walraven; #38R

.3 Adjustable Swivel Ring Band: MSS SP 58, Type 10

.1 Anvil International Inc.; Fig. 69

.2 Cooper B Line Inc.; Fig. B3170

.4 Adjustable Roller Hanger c/w Steel Protection Saddle: MSS SP 58, Type 41, 43 or 45 c/w Type 39

.1 Anvil International Inc.; Fig. 171, 177 or 181 c/w Figure 160 to 166A

.5 Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

.6 See section 2.3 “Trapeze Support System”

2.3 TRAPEZE TYPE SUPPORT SYSTEMS

.1 Trapeze Hanger/Support: MSS SP 58, Type 59

.2 Channel Size: to meet design requirements. Minimum 12 gauge, 1 5/8 inch wide steel. Minimum 1 1/2 inch wide FRP.

.3 Members and Connections: Design for all loads with safety factor of 5.

.4 Pipe Anchors Type: Galvanized steel anchor chair with U bolt strap.

.5 Manufacturers:

.1 Anvil International Inc.; Power Strut.

.2 Cooper B Line Inc.; Strut System.

.3 Unistrut Corporation.

.4 TYCO Inc. - Aickenstrut (FRP).

.5 Gripple Inc.

.6 Eaton

.7 Commercial Roll Formed Products Ltd.

.8 Aimco International Group

2.4 HORIZONTAL PIPE ON VERTICAL SURFACES:

.1 Steel offset pipe clamp:

.1 Anvil International Inc.; Fig. 103

.2 E. Myatt & Co. Inc. Fig. 170

.2 J-Hanger, MSS SP 58, Type 5:

.1 Anvil International Inc.; Fig. 262

.2 Cooper B Line Inc.; Fig. B3690

.3 See section 2.5 “Wall Brackets”

2.5 WALL BRACKETS

.1 Welded Steel Bracket: MSS SP 58 and SP 69, Type 33 (heavy-duty).

.1 Anvil International Inc.; Fig. 199

.2 Cooper B Line Inc.; Fig. B3067

.2 Pipe Anchors Type: Galvanized steel anchor chair with U bolt strap.

.3 One Hole Clamp: Anvil International Inc.; Figure 126.

.4 Channel Type:

.1 Unistrut Corporation.

.2 Anvil International Inc.; Power Strut.

.3 Cooper B Line Inc.; Strut System.

.4 TYCO Inc. - Aickenstrut (FRP).

.5 Gripple Inc.

2.6 VERTICAL RISERS THROUGH FLOORS:

.1 Riser clamp, MSS SP 58, Type 8:

.1 Anvil International Inc.; Fig 121,

.2 E. Myatt & Co. Inc. Fig. 151

.3 Taylor/Walraven; #82

.2 Heavy-duty steel riser clamp MSS SP 58, Type 8:

.1 Anvil International Inc.; Fig. 261

.2 E. Myatt & Co. Inc.; Fig's. 182,183, 190 and 191

.3 Base of Vertical Risers: Support for vertical risers in excess of 6 m (20') high extending out from base mounted equipment shall consist of a base elbow support with flange Empire Tool & Mfg. Co. Fig. 830 or approved equivalent.

2.7 VERTICAL PIPING ON VERTICAL SURFACES:

.1 Adjustable Split Ring Pipe Clamp: MSS SP 58, Type 6 or 12.

.1 Anvil International Inc.; Fig. 104

.2 Cooper B Line Inc.; Fig. B3198H

.2 Steel offset pipe clamp:

.1 Anvil International Inc.; Fig. 103

.2 E. Myatt & Co. Inc. Fig. 170

.3 Heavy-duty steel pipe strap: MSS Type 26

.1 Anvil International Inc.; Fig. 262

.2 E. Myatt & Co.; Fig. 161

2.8 PIPE GUIDES

.1 Intermediate Guides:

.1 Piping 150 mm and Smaller: Specify the use of pipe clamp with oversize pipe sleeve to provide a minimum of 3 mm of clearance.

.1 Manufacturers:

.1 Kin Line, Inc., Figure 417.

.2 Grinnell (division of Tyco Fire Products LP): Power Strut, Figure P5932.

.2 Piping 200 mm and Larger: Specially formed U bolts with double nuts to provide a minimum clearance of 6 mm around pipe.

.1 U Bolt Stock Size:

.1 200 mm Pipe: 16 mm U bolt.

.2 250 mm Pipe: 400 mm U bolt.

.3 300 through 400 mm Pipe: 22 mm U bolt.

.4 450 through 760 mm Pipe: 25 mm U bolt.

.2 Alignment Guides:

.1 Piping 200 mm and Smaller: Galvanized steel spider or sleeve type.

.2 Piping 250 mm and Larger: Galvanized roller type guides.

.3 Manufacturers:

.1 Vibrant Power Inc.

.2 Senior Flexonics Canada Ltd.

.3 Kin-Line Inc.

2.9 THERMAL BREAKS

.1 All insulated piping shall be provided with a continuous thermal break between the outer pipe diameter and the pipe hanger/support.

.2 Calcium silicate (or approved equivalent high density insulation) pre-insulated support shield c/w galvanized steel jacket.

.3 Manufacturers:

.1 Cooper B Line Inc.; B3380 thru B3387

.2 National Pipe Hanger Corp.; Pro-Shield

2.10 ACCESSORIES

.1 I-Beam Clamp: Concentric loading type, MSS SP 58, Type 21, 28, 29, or 30, which engage both sides of flange.

.2 Concrete Insert: MSS SP 58, Type 18, continuous channel insert with load rating not less than that of the hanger rod it supports.

.3 Concrete Anchors:

.1 Hilti (Canada) Co. type HIT or HSL anchors of size and numbers to resist the design loads based on a Factor of Safety (FOS) of 5.

.2 DeWalt Bantam Plug or equivalent, Plastic Wall Anchors, for lightweight applications only, size and numbers to resist the design loads based on a Factor of Safety (FOS) of 5

.4 All fasteners to be sized by the equipment manufacturer.

.5 Insulation Saddle:

.1 Type: Galvanized steel or stainless steel, MSS SP 58 and SP 69, Type 40.

.2 Manufacturers and Products:

.1 Anvil International Inc.; Figure 167.

.2 Cooper B Line Inc.; Figure B3151.

.6 Vibration Isolation Pads:

.1 Type: Neoprene Waffle.

.2 Manufacturers and Products:

.1 Mason Industries Inc.; Type W.

.2 Korfund Dynamics (division of Aeroflex Inc.); Korpad 40

2.11 ROOF MOUNTED SUPPORTS

.1 Lexsuco Corp.Lexcor "Flash-Tite" insulated aluminum support risers with the diameter, height, securement method and flashing to suit the application, channel type aluminum cross members, and galvanized steel pipe hangers and/or supports conforming to MSS SP-58 complete with all required accessories.

.2 Portable Pipe Hangers (Canada) Inc. (905-731-8104) "PP" Series or NVENT "CADDY" Series prefabricated portable pipe support system components to suit the pipe, complete with bases, galvanized structural steel frames, and galvanized steel pipe hangers and/or supports conforming to MSS SP-58 complete with all required accessories.

.3 Thaler Metal Industries “ARS” and “MERS” series adjustable height, epoxy coated, urethane insulated hollow steel supports including appropriate hardware (adhesive fasteners supplied by others) for fastening to structural roof deck, and cap / plate assembly designed for affixing equipment, piping, or ductwork as shown on drawings; manufacturer’s standard urethane insulated 1.6 mm (0.064”) mill finish 1100-0T alloy aluminum flashing with EPDM Base Seal. Contractor to select PVC coated deck flange for PVC roof membranes and/or bituminous painted deck flange for BUR and ModBit roof membrane (coordinate with roofing supplier/type). When hanging piping provide galvanized steel pipe hangers and/or supports conforming to MSS SP-58 complete with all required accessories.

2.12 SPECIAL HANGERS AND SUPPORTS:

.1 **Vibration isolated supports** – Black steel riser clamps as specified above, complete with vibration isolation pads Vibro-Acoustics Ltd. type “NSN” between the clamp and the floor or approved equivalent.

.2 **For groups of pipes having the same slope** – Welded steel brackets Anvil Fig. 195 or approved equivalent, universal trapeze assemblies Anvil Fig. 46, or Unistrut Corporation or approved equivalent assemblies, all with U-bolts, clamps, etc., to secure pipes in place. For pipes 150 mm ("6) and greater Anvil Fig. AS 911 pipe roller with Anvil Fig. 160 to 166A – MSS SP 58, Type 39 steel protection saddle or approved equivalent.

.3 **For sections of piping connected to vibration isolated equipment** – hangers and supports as specified above but complete with MSS SP 58, Type 48 spring cushions.

.4 **For plastic piping** – generally as specified above but in accordance with the pipe manufacturer’s printed recommendations.

.5 **For bare copper piping** – generally as specified above but factory vinyl coated to prevent contact between the pipe and hanger.

.6 **Special hangers and support** – “Gripple Systems” for suspension and bracing of building serviced, generally as specified above but in accordance with the manufacturer’s printed recommendations and as approved by Authority Having Jurisdiction.

.7 Nonmetallic (FRP) Channel Framing System:

.1 FRP channel shall be of pultruded glass-reinforced polyester or vinyl ester resin.

.2 Glass-reinforced channels shall have a flame/smoke spread rating of 25/50 or less when tested per ASTM E84 and meet the requirements of UL 94V-0.

.3 With Contract Administrator pre-approval, accessories may be of injection molded, 40% long glass fiber reinforced polyurethane, or nylon.

.4 Nonmetallic Channel Framing shall be furnished as a system which includes all the necessary fasteners, rods, channel splice plates, brackets, sealants, hangers, struts, clevis pipe hangers, pipe clamps, etc.

.5 Nonmetallic fasteners shall be manufactured from long glass fibre reinforced polyurethane to ensure maximum strength and corrosion resistance.

.6 Glass-reinforced channel shall have a synthetic surfacing veil applied on exterior surfaces to improve weatherability and inhibit ultraviolet degradation. An ultraviolet stabilizer shall be incorporated in the resin formulation to further inhibit ultraviolet degradation.

.7 Channel shall incorporate flange profile design which allows full and positive interlocking contact of channel accessories and prohibits premature flange failure from torqued accessories.

.8 All components of the Channel Framing System shall be nonmetallic except where type 316L stainless steel hardware is used as part of the assembly.

.9 The manufacturer shall not have had less than 10 years' experience in manufacturing strut systems.

3 Execution

3.1 INSTALLATION OF PIPING SUPPORTS

.1 All drilling for hangers, rod inserts and work of similar nature shall be done by Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems Divisions.

.2 General:

.1 Install pipe support systems in accordance with applicable codes, reference standards, manufacturer recommendations, and good industry practice unless shown otherwise on the Contract Drawings.

.2 Support piping connections to equipment by pipe support and not by the equipment.

.3 Support large or heavy valves, fittings, and appurtenances independently of connected piping.

.4 No pipe shall be supported by any other pipe located above, below or beside it.

.5 Do not install pipe supports and hangers in equipment access areas or bridge crane runs.

.6 Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.

.7 Install sway prevention bracing for all suspended piping in accordance with the requirements of NBC.

.8 All drilling for hangers, rod inserts and work of similar nature shall be done by Mechanical Division.

.9 Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.

.10 Repair mounting surfaces to their original condition after attachments are made.

.11 Install concrete anchors in accordance with the Manufacturer's printed instructions.

.12 Install resilient hangers in accordance with Section 20 05 48 – Vibration & Noise Control.

.13 Install additional seismic supports in accordance with Section 20 05 50 – Seismic Restraint System, as applicable.

.3 Standard Pipe Supports:

.1 Horizontal Suspended Piping:

.1 Single Pipes: Adjustable swivel ring, split ring, or clevis hangers.

.2 Grouped Pipes: Trapeze hanger systems.

.3 Furnish galvanized steel protection shield and oversized hangers for insulated pipe.

.4 Furnish precut sections of rigid insulation with vapor barrier at hangers for insulated pipe.

.2 Horizontal Piping Supported From Vertical Surface:

.1 Single Pipes: Wall brackets or J-Hangers attached to wall with anchors. Clamps attached to wall mounted framing are also acceptable.

.2 Stacked Piping:

.1 Wall mounted framing system and clamps acceptable for piping smaller than 75 mm minimal diameter.

.2 Piping clamps that resist axial movement of pipe through support are not acceptable.

.3 Wall mounted piping clamps are not acceptable for insulated piping.

.3 Horizontal Piping Supported From Floors:

.1 Stanchion Type:

.1 Pedestal type; adjustable with stanchion, saddle, and anchoring flange.

.2 Use yoked saddles for piping whose centerline elevation is 450 mm or greater above floor and for exterior installations.

.3 Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.

.2 Floor Mounted Channel Supports:

.1 Use for piping smaller than 75 mm nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.

.2 Attach channel framing to floors with anchor bolts.

.3 Attach pipe to channel with clips or pipe clamps.

.3 Concrete Cradles: Use for piping larger than 75 mm along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.

.4 Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.

.5 Standard Attachments:

.1 To Concrete Ceilings: Concrete anchors.

.2 To Steel Beams: I beam clamp or welded attachments.

.3 To Wooden Beams: Lag screws and angle clips to members a minimum of 62.5 mm thick.

.4 To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.

.4 Intermediate and Pipe Alignment Guides:

.1 Provide pipe alignment guides (or pipe supports that provide same function) at expansion joints and loops.

.2 Guide piping on each side of expansion joint or loop at 4 and 14 pipe diameters from each joint or loop.

.3 Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

.5 Accessories:

.1 Insulation Shield: Install on insulated piping. Oversize rollers and supports.

.2 Welding Insulation Saddle: Install on insulated steel pipe. Oversize rollers and supports.

.3 Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.

.1 Dielectric Barrier: 6.4 mm by 75 mm neoprene rubber wrap, oversize clamps

.2 Where factory applied electrical isolation between carbon steel members and copper is not possible wrap pipe with neoprene strip at hanger

.3 Install neoprene between stainless steel supports and non-stainless steel ferrous metal piping.

3.2 INSTALLATION OF DUCT SUPPORTS

.1 All drilling for hangers, rod inserts and work of similar nature shall be done by HVAC, Industrial and Process systems Divisions.

.2 Hang all ductwork securely and in a rigid manner. Provide hangers as described in Section 1.5 “Design Requirements”

.3 **Rectangular Duct Support Inside Building:** Support horizontal rectangular ducts inside the building in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible, but use trapeze hangers with galvanized steel channels and galvanized steel hanger rods for all ducts that are exposed, and all concealed ducts wider than 500 mm (20 in.), refer to clause 2.1-C.

.4 **Round and Flat Oval Duct Support Inside Building:** Support round and flat oval ducts inside the building in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible. Unless otherwise specified in the Contract Documents, for both uninsulated and insulated ducts exposed in finished areas use bands and secure at the top of the duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If the duct is insulated, size the strap to suit the diameter of the insulated duct, refer to clause 2.1-C.

.5 **Flexible Duct Support Inside Building:** Unless otherwise specified in the Contract Documents support in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible, refer to clause 2.1-C.

.6 Install resilient hangers in accordance with Section 20 05 48 – Vibration & Noise Control.

.7 Install additional seismic supports in accordance with Section 20 05 50– Seismic Restraint System, as applicable.

3.3 INSTALLATION OF ROOF MOUNTED SUPPORTS

.1 Supply supports for roof mounted equipment, piping, and ductwork.

.2 Hand the adjustable structural supports to the roofing trade on the roof for installation and flashing into roof construction as part of the roofing work specified in Division 7. Accurately mark the exact locations and spacing of the structural supports and supervise installation. Provide properly sized hot dip galvanized structural steel angles between structural supports and secure in place on support studs. Support piping and ductwork on the angles and provide galvanized steel banding to secure ducts to the angles.

.3 Accurately mark the location and spacing of roof support assemblies. At each plastic base location, carefully scrape away loose roof ballast (gravel) and all other debris and dirt. Prime the existing membrane with a primer which is compatible with existing roofing components. Set bases in adhesive in accordance with the manufacturer's installation instructions. Scrape loose ballast back around and on the bases. Install framing, piping, and ductwork on the cross-members. Secure piping and ductwork to cross-members with galvanized steel clamps and banding.

.4 Install additional seismic supports in accordance with Section 20 05 50 – Seismic Restraint System, as applicable.

3.4 FIELD FINISHING

.1 Paint: As specified in Section 09 90 00 – Painting.

END OF SECTION

1 General

1.1 SUMMARY

.1 This section covers the supply and installation of the complete vibration isolation system for all equipment, ductwork, and piping covered by the Contractor.

.2 Vibration isolation system shall be fully integrated into and compatible with noise and vibration controls in accordance with 20 05 50 - Seismic Restraint Systems, as applicable.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 20 05 29 – Hangers and Supports.

.3 Section 20 05 50 – Seismic Restraint System, as applicable.

1.3 REFERENCE STANDARDS

.1 American Society of Heating, Refrigerating, and Air Condition Engineers (ASHRAE)

.1 ASHRAE Handbook: HVAC Applications “Chapter 43 Sound and Vibration Control”

.2 National Building Code 2020 (NBC)

1.4 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Shop Drawings:

.1 Provide the manufacturer's product literature and datasheets for all components listed in this specification.

.2 Include full details of design criteria, schematics, specifications, installation procedures and instructions.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into O&M manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 GENERAL

.1 All equipment provided for vibration isolation shall be new and manufactured specifically for the purpose intended.

.2 All vibration isolation devices shall be Vibro-Acoustics, Kinetics Noise Control or Mason Industries and shall be one manufacturer throughout the project.

.3 Provide vibration isolation with integral seismic restraint for equipment intended to provide restraint from seismic and wind forces. Housings shall be capable of withstanding the applicable design forces for the specific installation. Installation shall be in accordance with Section 20 05 50 - Seismic Restraint Systems, as applicable.

2.2 VIBRATION ISOLATION

.1 Type EP (Elastomeric Pad)

.1 Type EP shall be 8mm thick ribbed or waffle neoprene pads. Isolator pads shall be selected for less than 80% maximum rated load.

.2 If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.

.3 Acceptable Manufactures:

.1 Vibro-Acoustics; Model N.

.2 Kinetics; Model NPD.

.3 Mason Industries; Model W or Super W.

.4 ISOTECH Industries

.2 Type MEP (Metal and Elastomeric Sandwich Pad)

.1 Type MEP shall consist of two 8mm thick ribbed or waffle neoprene pads bonded to each side of a 16-gauge stainless or galvanized steel shim plate. Isolator pads shall be selected for less than 80% maximum rated load.

.2 If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved shall be installed under the bolt head between the steel washer and the base plate.

.3 Acceptable Manufactures:

.1 Vibro-Acoustics; Model NSN.

.2 Kinetics Model; NGS.

.3 Mason Industries; Model WSW.

.4 ISOTECH Industries

.3 Type DDNM (Double Deflection Neoprene Mounts)

.1 Type DDNM shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in the base. The mounts shall have leveling bolts rigidly secured to the equipment.

.2 DDNM mounts shall be selected for a static deflection of 9.5mm unless specified otherwise.

.3 Acceptable Manufactures:

.1 Vibro-Acoustics; Model RDM.

.2 Kinetics; Model RD.

.3 Mason Industries; Model ND.

.4 ISOTECH Industries

.4 Type DDNH (Double Deflection Neoprene Hangers)

.1 Type DDNH shall consist of a molded neoprene isolating element in a steel hanger box. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel. The diameter of the clear hole in the hanger box shall be at least 19mm larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30 degree arc. When installed the hanger box shall be allowed to rotate through a full 360 degrees without encountering an obstructions.

.2 Unless otherwise specified the static deflection of DDNH hangers shall be 8mm.

.3 Acceptable Manufacturers:

.1 Vibro-Acoustics; Model RHD.

.2 Kinetics; Model RH.

.3 Mason Industries; Model HD.

.4 ISOTECH Industries

.5 Type SPNM (Spring and Neoprene Mounts)

.1 Type SPNM shall have a free standing and laterally stable steel spring without any housing, and two type WP isolation pads sandwiching a 16 gauge stainless or galvanized steel separator plate shall be bonded to the isolator base plate. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall not be less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.

.2 Unless otherwise specified the minimum static deflection of SPNM isolators under actual load conditions for equipment mounted on grade slabs shall be 25 mm (1 in.), and 50 mm (2 in.) for equipment mounted above grade level.

.3 Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If base plates are bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.

.4 Acceptable Manufacturers:

.1 Vibro-Acoustics; Model FS.

.2 Kinetics; Model FDS.

.3 Mason Industries; Model SLFSW.

.4 ISOTECH Industries

.6 Type SPNMS (Spring and Neoprene Mounts – Seismic Restrained)

.1 Type SPNMS shall be laterally stable restrained steel spring type. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall not be less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.

.2 Unless otherwise specified the minimum static deflection of SPNMS isolators under actual load conditions for equipment mounted on grade slabs shall be 25 mm (1 in.), and 50 mm (2 in.) for equipment mounted above grade level.

.3 Isolators shall be bolted to the floor and equipment. Provide a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.

.4 Acceptable Manufacturers:

.1 Vibro-Acoustics; Model SFS.

.2 Kinetics; Model FHS.

.3 Mason Industries; Model SSLFH.

.4 ISOTECH Industries

.7 Type SPH (Spring Hangers)

.1 Type SPH shall consist of a steel spring and welded steel housing. Spring diameter and hanger box hole shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 19 mm (3/4 in.) larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions.

.2 Unless otherwise specified, the static deflection of SPH hangers under actual load conditions shall be 50 mm (2 in.).

.3 Acceptable Manufacturers:

.1 Vibro-Acoustics; Model SH.

.2 Kinetics; Model SH.

.3 Mason Industries; Model 30.

.4 ISOTECH Industries

.8 Type SPNH (Spring and Neoprene Hangers)

.1 Type SPNH shall be as above with the addition of a neoprene element in series with the spring. The neoprene element shall have a deflection of not less than 9mm with a strain not exceeding 15%. Unless otherwise specified, the static deflection of SPNH hangers under actual load conditions shall be 50 mm (2 in.).

.2 Acceptable Manufacturers:

.1 Vibro-Acoustics; Model SHR.

.2 Kinetics; Model SRH.

.3 Mason Industries; Model 30N.

.4 ISOTECH Industries

.9 Type CSNM (Constrained Spring and Neoprene Mounts)

.1 Type CSNM shall be a spring and neoprene mount that incorporates a housing which contains unrestrained stable springs with built-in leveling device and resilient vertical limit stops to prevent spring elongation when partial load is removed and limits the movement of equipment when it is subjected to wind loading.

.2 A minimum clearance of 25 mm (1 in.) shall be maintained around the restraining bolts and between the housing and the spring so as not to interfere with the spring operation. Limit stops shall provided minimum 6 mm (1/4 in.) clearance under normal operation, and a neoprene washer shall be installed beneath the bolt head/washer used to restrain the isolator.

.3 For Installations subject to wind load, provide tapped hole in top and bottom plates for bolting to equipment and the roof or supporting structure with a neoprene sleeve.

.4 Provide minimum 6mm thick neoprene acoustical base pad on the underside of the mount unless designated otherwise.

.5 Mount shall be capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical.

.6 Unless specified otherwise, the minimum static deflection for Type CSNM mounts under actual load conditions shall be 50 mm (2 in.).

.7 Acceptable Manufacturers:

.1 Vibro-Acoustics; Model CSR.

.2 Kinetics; Model FLS.

.3 Mason Industries; Model SLR.

.4 ISOTECH Industries

.10 Type SCSNM (Constrained Spring and Neoprene Mounts – Seismic Restrained)

.1 Type SCSNM shall be a spring and neoprene mount that incorporates welded steel housings and heavy top plates containing laterally stable restrained springs with built-in leveling device and vertically restraining limit stops to prevent spring elongation when partial load is removed and limits the movement of equipment when it is subjected to wind or seismic loading.

.2 A maximium clearance of 6 mm (1/4 in.) shall be maintained around the restraining bolts and between the housing and the spring so as not to interfere with the spring operation. Top plate and restraining bolts shall be out of contact with the housing during normal operation.

.3 Provide tapped hole in top and bottom plates for bolting to equipment and the roof or supporting structure with a neoprene sleeve.

.4 Provide minimum 6mm thick neoprene acoustical base pad on the underside of the mount unless designated otherwise.

.5 Mount shall be capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical.

.6 Unless specified otherwise, the minimum static deflection for Type SCSNM mounts under actual load conditions shall be 50 mm (2 in.).

.7 Acceptable Manufacturers:

.1 Vibro-Acoustics; Model SCSR.

.2 Kinetics; Model FLSS.

.3 Mason Industries; Model SLRS.

.4 ISOTECH Industries

.11 Type SB (Steel Base)

.1 Type SB inertia base which shall be a structural steel base frame with clearance holes located to correspond to the mounting bolt holes of the equipment mounted on the base. Fan bases shall have built-in motor slide rails, and shall be reinforced as necessary to withstand belt pull without drive misalignment or base distortion.

.2 The bases shall be constructed with deep angle steel sections with a minimum vertical angle leg of 100 mm (4 in.) for motors of 7.5 hp or less, 125 mm (5 in.) for motors between 7.5 hp and 20 hp, and 150 mm (6 in.) for motors over 20 hp.

.3 Structural steel base frames shall be prime-painted (galvanized).

.4 Acceptable Manufacturers:

.1 Vibro-Acoustics; Model S.

.2 Kinetics; Model SFB.

.3 Mason Industries; Model MSLFSW.

.4 ISOTECH Industries

.12 Type CB (Concrete Base)

.1 Type CB inertia base shall have an integral rectangular structural steel form to which concrete is poured.

.2 Perimeter members shall be beams of depth equal to 10% of the longest span of the base, but not more than 300 mm (12 in.) or less than 150 mm (6 in.) deep. Forms shall include motor slide base and all reinforcing steel. Where anchor bolt locations fall in concrete, the reinforcing steel shall include drilled members with sleeves welded below the steel to accept the anchor bolts. Height saving steel brackets shall be used in all mounting locations.

.3 When the concrete base is T-shaped, isolators shall be located under the projections as well as under the main body in order to prevent cantilever distortion.

.4 Inertia bases for pumps shall be of sufficient size to accommodate supports for pipe elbows at pump suction and discharge connections.

.5 Height saving brackets or welded steel pockets shall be incorporated in ensure a 50 mm (2 in.) minimum clearance under each inertia base.

.6 The weight of each inertia base shall be sufficient to lower the centre of gravity to or below the isolator support plane.

.7 The structural perimeter frame, mounting templates, height saving brackets, and spring system shall be provided as an assembly by the vibration control vendor.

.8 Structural perimeter frames shall be prime-painted (galvanized).

.9 Acceptable Manufactures:

.1 Vibro-Acoustics; Model C.

.2 Kinetics Model; CIB-L.

.3 Mason Industries; Type KSLFSW.

.4 ISOTECH Industries

.13 All spring mounts shall be complete with levelling devices 6 mm (1/4 in.) thick ribbed neoprene sound pads and completely colour coded stable springs.

.14 Where steel spring isolation systems are described in the specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 80% of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel during and after spring installation.

.15 All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50% above the design deflection.

.16 All vibration isolators shall have either known undeflected heights of calibration markings to that, after adjustment, verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to design.

.17 All mounts installed outdoors or exposed to high humidity conditions shall have two coats of rust resisting paint and springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated. All metal parts of mountings (except springs and hardware) shall be hot dip galvanized.

.18 Neoprene mounting sleeves for hold down applications of equipment with vibration isolators shall be Uniroyal Type 620/660 or as approved.

.19 Grout: Non-shrink, self-levelling grout having ability to withstand thermal, vibratory and impact stresses; “Embeco 636 Grout”, “Imperial Grout”, or “Sauereisen F-100”.

3 Execution

3.1 GENERAL

.1 Obtain one copy of all Shop Drawings of equipment to be isolated showing weights, shaft centres and all dimensions.

.2 On system start-up, inspect the complete installation and provide a report in writing.

.3 Furnish concrete bases, including concrete fill, on springs or other vibration isolation materials for mechanical isolation.

.4 All floor mounted equipment shall be erected on concrete housekeeping pads, with thickness as identified, over the complete floor area of the equipment, unless shown or specified otherwise. Wherever vibration eliminating devices and/or concrete inertia pads are specified, these items shall be mounted on concrete housekeeping pads.

.5 Furnish and install neoprene mounting sleeves for hold-down bolts to prevent any metal to metal contact.

.6 All equipment shall be provided with lateral restraining isolators as required to limit horizontal motion to 6mm maximum, under all operating conditions. Lateral restraining isolators shall have the same static deflection as equipment being isolated.

.7 Seismic snubbers shall be installed on all equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 3.2mm (1/8 in.). Install seismic restraint devices using methods approved by required submittals for component.

.8 Unless otherwise indicated, all equipment mounted on vibration isolators shall have a minimum operating clearance of 50 mm (2 in.) between the bottom of the equipment or inertia base (and height saving bracket) and the concrete housekeeping pad (or bolt heads) beneath the equipment. The clearance shall be checked by the Contractor to ensure that no material has been left to short circuit the vibration isolators. There shall be a minimum 100 mm (4 in.) clearance between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

.9 Piping, ductwork, conduit or mechanical equipment shall be supported from building structure, not hung from or supported on other equipment, pipes, or ductwork.

.10 Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping, and blocked up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.

.11 All mechanical equipment not specifically identified in this Section that contains rotating or vibrating elements, and any associated electrical apparatus installed by this Division that contains transformers or inductors shall be installed on Type DDNM, MEP, or EP isolators as appropriate.

.12 All wiring connections to mechanical equipment on isolators shall be made with a minimum long flexible conduit installed in a slack "U" shape.

.13 Elastomeric isolators that will be exposed to temperatures below 0 deg. C. (32 deg. F.) shall be fabricated from natural rubber instead of neoprene.

.14 Springs shall be designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.

.15 Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.

.16 Fans and air handling units shall be levelled with fans operating before the flexible connectors are attached.

.17 All fan bases and isolators shall be sized so that thrust restraints (which would act against turning moment caused by static pressure) are not required.

3.2 INSTALLATION OF VIBRATION ISOLATION

.1 Floor Mounted Centrifugal Fans and axial flow fans less than 0.87 kPa (3-1/2 in. W.G.) static pressure and/or under 29.8 kW (40 hp), shall be mounted on a Type SB base with Type SPNM isolators and shall have static deflection shall not be less than 50mm under actual load conditions unless shown otherwise in the Contract Drawings.

.2 Floor Mounted Centrifugal Fans and axial fans 0.87 kPa (3-1/2 in. W.G.) static pressure and over and/or 29.8 kW (40 hp) and larger, shall be mounted on Type CB with Type SPNM isolators and shall have static deflection not less than 50 mm (2 in.) under actual load conditions unless stated otherwise on the Contract Drawings.

.3 Ceiling Suspended Centrifugal Fans, and axial flow fans shall be mounted on Type SPNH spring isolators. Static deflection of the isolators shall be 50 mm (2 in.) unless shown otherwise on the Contract Drawings. Fans shall be suspended from above only if expressly noted as such on the Drawings and Schedules. Thrust restraint shall be by pre-compressed springs.

.1 If the fan to be suspended is not furnished with integral structural frame and external mounting lugs of suitable strength and rigidity, install approved structural base with lugs in the field.

.4 Fans in packaged or custom air handling units shall be mounted on a Type SB base with Type SPNM isolators. The static deflection shall not be less than 50 mm (2 in.) under actual load conditions.

.1 Structural steel floor supports shall be located beneath the spring isolators and shall be equivalent to the structural perimeter frame of the air handling unit.

.5 Vertical in-line pumps floor mounted 6.5 kW (10 hp) and larger except where located on slab-on-grade bolt and grout each elbow support to a Type CB inertia base. The minimum base thickness shall be:

Table 1: Vibration isolation for vertical in-line pumps.

Pump Size	Inertia Base Thickness
Pumps 6.5 kW (10 hp) to 18.7 kW (25 hp)	200 mm (8 in.)
Pumps 22.4 kW (30 hp) to 74.6 kW (100 hp)	250 mm (10 in.)
Pumps 93.3 kW (125 hp) and larger	300 mm (12 in.)

.1 Mount the base on Type SPNMS isolators.

.2 Pour bases on roofing felt and elevate a minimum of 50 mm (2 in.) with mounting adjustment bolts after the pump elbows are grouted to the base.

.3 No damping or snubbing materials shall be used. Spring deflection shall be as specified in the Contract Drawings, but in no case less than 25 mm (1 in.) and all mountings shall have 6 mm (1/4 in.) thick neoprene vibration isolation pads at the bottom.

.6 Vertical in-line pumps floor mounted 4.9 kW (7-1/2 hp) and smaller and 6.5 kW (10 hp) and larger where located on slab-on-grade, shall be supported on Type SPNMA isolation. Refer to Mechanical Standard Details.

.7 Vertical in-line pumps ceiling hung shall be supported by Type SPNH spring isolators. Refer to Mechanical Standard Details.

.8 Floor mounted air compressors shall be bolted and grouted to Type CB inertia base supported by Type SPNM isolators. Static deflection of the isolators shall be 50 mm (2 in.) unless shown otherwise on the Contract Drawings. Resilient pipe hangers shall be as specified for piping in Mechanical Rooms.

.9 Fan coil units or heat pumps suspended from overhead structure shall be hung on Type SPNH spring isolators. The static deflection of the isolators shall be 50 mm (2 in.).

.10 Chillers shall be mounted on a Type SB base with CSNM isolators. Spring deflection shall be 50 mm (2 in.) minimum.

.11 Boilers (slab-on-grade) and gas-fired domestic water heaters shall be mounted on a on Type MEP isolation. If the equipment is suitable and an additional steel base is not required, the equipment can be mounted directly on the isolators.

.12 Suspend all piping in Mechanical Rooms on Type SPH or SPNH isolators as required. Where piping is supported from the floor, weld brackets to the piping and support on Type SPNM isolators. Isolators do not replace constant support hangers or mounts.

.13 The first isolator both upstream and downstream of equipment on springs shall have a static deflection of 1.5 times the deflection of the vibration isolated equipment to a maximum of 50 mm (2 in.). All other piping supports shall have a static deflection of 25 mm (1 in.) minimum.

.14 Where a pipe connects to multiple pieces of equipment in the Mechanical Room the pipe isolators for the entire run shall be chosen to suit the connected equipment of the greatest static deflection.

.15 Piping that is connected only to equipment installed on neoprene isolators shall be either supported from the floor by Type DDNM isolators or suspended from the structure on Type DDNH isolators within the Mechanical Equipment Rooms.

.16 Flexible piping connectors as specified in Section 23 21 16 - Hydronic Piping Specialties and/or Section 22 11 19 - Domestic Water Piping Specialties shall be installed to connect piping of diameter 50 mm (2 in.) or greater to reciprocating or rotating equipment.

.17 Piping attached to either coil sections separated from the fan sections of air handling units by flexible connections as specified in Section 23 21 16 - Hydronic Piping Specialties, or to air handling units with internal isolators meeting the requirements of these specifications is exempt from these requirements and is not considered connected to vibrating equipment.

.18 No rigid connections between equipment and the building structure shall be made that degrades the specified noise and vibration control system.

.19 Locate isolation hangers with the housing a minimum of 50 mm (2 in.) below but as close as possible to the structure. Where isolator hangers would be concealed by a non-accessible acoustical sub-ceiling, install the hangers immediately below the sub-ceiling for access.

.20 Ducts shall be connected to fans, fan casings and fan plenums by means of flexible connectors. Flexible connectors shall be installed to prevent metal-to-metal contact across flexible connection. Flexible duct connectors shall not be used outside the Mechanical Room unless expressly shown on the Drawings. Flexible connectors shall be in accordance with Section 23 33 00 - Air Duct Accessories.

END OF SECTION

1 General

1.1 SUMMARY

.1 This section covers design, supply and installation of complete Seismic Force Resisting System (SFRS) for all mechanical, process, industrial and electrical equipment, ductwork, and piping covered by the Contractor.

.2 SFRS shall be fully integrated into and compatible with noise and vibration controls in accordance with Section 20 05 48 – Vibration Isolation and Noise Control.

.3 Systems and equipment shall be required to be operational during and after a seismic event.

.4 During a seismic event, SFRS shall prevent systems and equipment from causing personal injury and from moving from normal position.

.5 Design shall be by a Professional Engineer specializing in the design of SFRS and registered in the Province of Project.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 20 05 29 – Hangers and Supports.

.3 Section 20 05 48 – Vibration Isolation.

.4 Section 22 11 19 – Domestic Water Piping Specialties.

.5 Section 22 13 16 – Drainage Waste and Venting Piping.

.6 Section 23 30 00 – HVAC Ducts and Plenums.

.7 Division 11, 14, 20, 21, 22, 23, 25, 26, 41.

1.3 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-S832, Guideline for Seismic Risk Reduction of Operation and Function Components (OFCs) of Buildings

.2 Manufacturers Standardization Society (MSS)

.1 ANSI/MSS SP-127, Bracing for Piping Systems: Seismic-Wind-Dynamic Design, Selection, and Application.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 ANSI/SMACNA 006, HVAC Duct Construction Standards - Metal and Flexible

.2 SMACNA, Seismic Restraint Manual - Guidelines for Mechanical Systems and Plumbing Piping Systems

.4 National Building Code 2020 (NBC)

.5 ASHRAE

1.4 DEFINITIONS

.1 Relevant Importance Category for the Building in accordance with the National Building Code:

.1 As defined in Structural DWGs.

.2 As per City of Winnipeg requirements.

.2 SFRS: acronym for Seismic Force Resisting System.

.3 SCS: acronym for Slack Cable Restraint System.

1.5 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings shall include:

.1 Full details of design criteria.

.2 Working drawings, materials lists, schematics, and full specifications for all components of each SFRS to be provided.

.3 Design calculations (including restraint loads resulting from seismic forces in accordance with SMACNA Seismic Restraint Manual and National Building Code, detailed work sheets, tables).

.4 Separate shop drawings for each SFRS and devices for each system and equipment.

.5 Identification of location for each device.

.6 Schedules of types of SFRS equipment and devices.

.7 Details of fasteners and attachments to structure, anchorage loadings, and attachment methods.

.8 Installation procedures and instructions.

.9 These drawings shall be designed and bear the seal of a Professional Engineer licensed to practice in the appropriate discipline and in the Place of Work.

.3 After the SFRS/SCS has been installed the manufacturer shall conduct a site visit, and provide a letter of confirmation, stating that system has been installed and is functioning as per the manufacturer design requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 SEISMIC FORCE RESTRAINT SYSTEM (SFRS)

.1 Design, supply and install seismic restraints for all equipment, ductwork and piping covered by Contractor except as noted herein.

.2 Design and installation of SFRS shall follow the guidelines listed in CAN/CSA-S832 and the SMACNA Seismic Restraint Manual (unless specifically overridden by this Section). Where contradictions occur the more stringent requirement shall be followed.

.3 Provide positive seismic and wind restraints on all systems and components required by the National Building Code and the Authority Having Jurisdiction (AHJ).

.4 Refer to Structural Division for additional information/ requirements and coordinate anchorage points, location, and installation requirements.

.5 Fasteners and attachment points shall resist the same load as seismic restraints.

.6 The SFRS shall restrain seismic forces in all directions.

.7 SFRS of Piping systems shall be compatible with:

.1 Expansion, anchoring and guiding requirements.

.2 Equipment vibration isolation and equipment SFRS.

.8 SFRS utilizing cast iron, threaded pipe, and other brittle materials shall not be permitted.

.9 Attachments to concrete structure:

.1 Use high strength mechanical expansion anchors.

.2 Drilled or power-driven anchors shall not be permitted.

.10 Seismic control measures shall not interfere with integrity of fire stopping.

.11 Piping and ductwork crossing building expansion joints shall have provision for building motion.

.12 Provide seismic restraints for all flues with a minimum of 1 transverse and 1 lateral brace. Restraints shall be designed as per ductwork of equivalent weight.

.13 The SFRS shall provide gentle and steady cushioning action and avoid high impact loads.

.14 Unless indicated otherwise indicated, seismic restraints shall be capable of a minimum 2g horizontal force in any direction.

.15 The SFRSs shall be from a single manufacturer, acceptable manufacturers:

.1 Kinetics Noise Control Inc.

.2 Mason Industries Inc.

.3 Vibro-Acoustics (Swegon Group).

.4 Gripple Inc.

2.2 SFRS FOR STATIC EQUIPMENT AND SYSTEMS

.1 Floor-mounted equipment and systems:

.1 Anchor equipment to equipment supports.

.2 Anchor equipment supports to structure.

.3 Use size of bolts scheduled in approved shop drawings.

.2 Suspended equipment and systems:

.1 Use one or combination of following methods:

.2 Install tight to structure.

.3 Cross-brace in all directions.

.4 Brace back to structure.

.5 Slack cable restraint system.

2.3 SFRS FOR VIBRATION ISOLATED EQUIPMENT

.1 Equipment installed on vibration isolation requiring seismic restraint shall be in accordance with Section 20 05 48 – Vibration and Noise Control.

2.4 SLACK CABLE RESTRAINT SYSTEM (SCS)

.1 Seismic cable sway bracing restraints shall consist of galvanized steel, or stainless steel in corrosive and or outdoor applications, aircraft cable sized to resist seismic loads with a safety factor of five (5). Cable end connections shall use heavy brackets, thimbles, and wire rope clips or compression sleeves.

.2 The SCS shall prevent sway in the horizontal plane, “rocking” in the vertical plane, sliding and buckling in an axial direction.

.3 Hanger rods shall be braced to withstand compressive loading and buckling. Hanger rods shall be in accordance with Section 20 05 29 – Hangers and Supports.

3 Execution

3.1 INSTALLATION OF SEISMIC FORCE RESTRAINT SYSTEM

.1 General:

.1 Restraining devices must be placed on all sides of equipment.

.2 Secure all control panels to withstand seismic loading.

.3 Provide additional steel brackets, inserts, bolts, cable, etc. to provide seismic restraints.

.4 For vibrating equipment:

.1 The installation of seismic restraints shall not compromise vibration isolation capabilities.

.2 Install vibrating equipment on seismically rated isolators whenever possible.

.3 Where seismically rated isolators cannot be used on vibrating equipment, use non-seismic isolators and provide slack cable restraints.

.5 For non-vibrating equipment, secure the equipment to the structure by:

.1 Bolting directly to the structure.

.2 Use rigid seismic restraints.

.3 Use taught cable restraints - not slack.

.4 Rigid restraints are preferable to cable restraints as cables have no compression load capabilities.

.6 Secure brackets.

.7 Inserts shall be installed in accordance to the manufacturer’s recommendations.

.8 Prior to the installation of any seismic restraints review with the Structural Contract Administrator the methods of attachment and loads. Be particularly aware of large loads and light steel structures.

.9 Where hanger length for piping, ductwork or equipment at a seismic bracing point exceeds 50f, provide additional rod support in accordance to SMACNA or use Mason SRC clamps.

.10 Where anchor bolt diameter is smaller than bolt hole, such as for a slot hole, use Mason 0.5 fast epoxy putty to fill gaps.

.11 Eleven (11) months after substantial performance, re-torque all bolts for seismic attachment and provide certificate, as part of this work the manufacturer shall verify that the vibration isolation does not interfere with the seismic restraint systems.

.2 Ductwork:

.1 Provide traverse bracing 9 m o.c. maximum. (Except rectangular ducts 1550 mm and larger in either direction may be braced at 9.8 m o.c.)

.2 Provide longitudinal bracing at 18.3 m o.c. maximum. Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it, if the bracing is installed within four feet of the intersection of both ducts and bracing is sized for the larger duct. Duct joints shall conform to SMACNA Duct Construction Standard. All joints in duct sections shall provide a positive fastening together of the section.

.3 A group of ducts may be combined in a larger size frame using the overall dimensions with maximum weight for selection of the members from the schedule on sheet 17 of the SMACNA Guidelines.

.4 Walls (including gypsum-board non-bearing partitions) which have ducts running through them may replace a typical transverse brace. Provide solid blockings around duct penetration at stud wall construction.

.5 Install ducts and pipes not braced with 1150 mm minimum clearance to vertical ceiling hanger wires.

.6 All sheet metal for bracing to be Fy (yield strength) = 33,000 psi.

.7 Minimum sheet metal for bracing to be 16 ga.

.8 It is the responsibility of the Contractor to ascertain that an appropriate size device be selected for each individual piece of equipment.

.3 Piping:

.1 Provide restraint details on piping and equipment as follows.

.2 Vertical Piping:

.1 Attachment - Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents. Stacks shall be supported at their bases and, if over 2 stores in height, at each floor by approved metal floor clamps.

.2 Screwed pipe - Screwed pipe (I.P.S.) shall be supported at not less than every other storey height.

.3 Copper tubing - Copper tubing shall be supported at each storey for piping 40 mm (1½") and larger diameter, and at not more than 1.8 m (6 ft.) intervals for piping 40 mm (1½") and smaller in diameter.

.4 Support pipes of other materials in accordance with the capability of the pipe to resist seismic loads.

.3 Horizontal Piping:

.1 Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.

.2 Screwed pipe - Screwed pipe (I.P.S.) or flanged pipe shall be supported at approximately 3 m (10 ft.) intervals.

.3 Copper tubing - Copper tubing shall be supported at approximately 1.8 m (6 ft.) intervals for tubing 40 mm (1½") and smaller in diameter and 3 m (10 ft.) intervals for tubing 50 mm (2") and larger id diameter.

.4 Support pipes of other materials in accordance with the capability of the pipe to resist seismic loads.

.4 Provide transverse bracings at 12.2 m (40 ft.) o.c. maximum unless otherwise noted.

.5 Provide longitudinal bracings at 24.4 m (80 ft.) o.c. maximum unless otherwise noted. When thermal expansion or contraction is involved, provide longitudinal bracings at anchor points. The longitudinal braces and the connections must be capable of resisting the force induced by expansion and contraction.

.6 Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed within 600 mm (24") of the elbow or tee of similar size.

.7 For threaded piping the flexibility may be provided by the installation of swing joints. In welded or solder joint piping the flexibility shall be provided by expansion loops or manufactured flexible connectors. For piping with manufactured ball joints select length of piping offset using "Seismic Drift" in place of "Expansion per Joint" in the manufacturer's selection table. Seismic Drift = 0.015 ft. per foot of height (15 mm/m of height).

.8 Do not use branch lines to brace main lines.

.9 Trapeze hangers may be used. Provide flexibility in joints where pipes pass through building seismic or expansion joints, or where rigidly supported pipes connected to equipment with vibration isolators.

.10 A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

.11 Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.

.12 At vertical pipe risers, wherever possible, support the weight of the riser at a point of points above the centre of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m (30 ft.) o.c.

.13 Cast iron pipe of all types, glass pipe and any other pipe joined with a shield and clamp assembly where the top of the pipe is 30 mm (12") or more from supporting structure shall be braced on each side of a change in direction of 90° or more. Riser joints shall be braced or stabilized between floors.

.14 For gas piping, the bracing details, schedules and notes may be used except that transverse bracing shall be at 6.1 m (20 ft.) o.c. maximum and longitudinal bracing at 12.2 m (40 ft.) o.c. maximum. NPS 1", 1¼", 1½" and 2" (25, 32, 40 & 50 mm) diameter pipes shall be braced the same as NPS 2½" (65 mm) diameter pipe in the schedule. (No bracing is required for pipes NPS 3/4" (20 mm) diameter and smaller.)

.15 The seismic bracing and support of fire sprinkler piping is not part of this specification.

.16 It is the responsibility of the Contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings.

.4 Attachment point and fasteners:

.1 Shall withstand the same maximum load that the seismic restraint is to resist and in all directions.

.2 Pipe installation shall comply with the most stringent requirement of MSS SP-127 or as indicated below.

.3 Install SFRS at least 25mm (1 in.) from all other equipment, systems, and/or services.

.4 Where specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

.5 Co-ordinate connections with all disciplines.

.6 Vertical tanks:

.1 Anchor through housekeeping pad to structure.

.2 Provide steel bands above center of gravity.

.7 Horizontal tanks:

.1 Provide at least two (2) straps with anchor bolts fastened to structure.

3.2 INSTALLATION OF SLACK CABLE RESTRAINT SYSTEMS

.1 Connect to suspended equipment so that axial projection of wire passes through center of gravity of equipment.

.2 Arrange bushing assemblies for anchor bolts for floor mounted equipment with resilient media between the anchor bolt and mounting hole in concrete base.

.3 Arrange bushing assemblies for anchor bolts for wall mounted equipment with resilient media where equipment or equipment mounting channels are attached to the wall.

.4 Alignment of restraints shall be installed to avoid bending of cables at connection points or across edges of adjacent equipment or building structure.

.5 Piping systems shall provide for transverse SCS at 12.2m (40 ft.) spacing maximum, longitudinal SCS at 24.4m (80 ft.) maximum or as limited by anchor/slack cable performance.

.6 Ducted systems shall provide for transverse SCS at 9.1m (30 ft.) spacing maximum, longitudinal SCS at 18.3m (60 ft.) maximum or as limited by anchor/slack cable performance.

.7 Brace a change in direction longer than 3.7m (12 ft.)

.8 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not the reverse arrangement.

.9 Orient restraint wires on ceiling hung equipment at approximately 90° to each other (in plan), tie back to structure at maximum of 45° to structure.

.10 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.

.11 Tighten cable to reduce slack to 38mm (1-1/2 in.) under thumb pressure. Cable shall not support weight during normal operation.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

1.2 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60-M, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3, Identification of Piping Systems.

.2 National Building Code 2020 (NBC)

1.3 DEFINITIONS

.1 For purposes of this Section:

.1 "CONCEALED" means mechanical services and equipment in suspended ceilings, non-accessible chases, and furred-in spaces.

.2 "EXPOSED" means "not concealed" as defined in this Section.

1.4 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Shop Drawings:

.1 Provide manufacturer product literature identifying size, type, material and colour of labels.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 PIPE IDENTIFICATION

.1 Contractor shall identify piping and equipment throughout with labels and direction of flow arrows regardless of whether or not specified elsewhere. Labelling shall be as per Painting Schedule or as requested by Contract Administrator if not covered in Schedule.

.2 Pipe Markers and Direction Arrows: This piping identification system lends itself to commercially available pipe markers having standard sizes of lettering and colours. Standard Colours designate classes of materials as follows, and are consistent with those specified by CAN/CGSB-24.

Colour	Material
Yellow	Dangerous Materials
Green	Safe Materials
Red	Fire Protection Equipment
Blue	Protective Materials

.3 Contractor may use stenciled lettering applied directly to pipe/duct insulation if approved on site by OMR and the Contract Administrator. Contractor shall send samples of stencils and photographs of application on to both OMR and Contract Administrator and receive written approval before application to system. All colours and symbols shall match the pipe markers described in this section. The Contractor shall replace any stenciling deemed as poor workmanship at no additional cost.

.4 Standard Pipe Identification:

.1 For pipes up to and including 150 mm (6") diameter markers shall be coloured, coiled, semi-rigid vinyl plastic of a length to wrap completely around the pipe, and indoor/outdoor type vinyl ink lettering and directional arrows. Alternatively, use coloured pressure sensitive adhesive-style acrylic markers installed with vinyl banding tape.

.2 For pipe larger than 150 mm (6") O.D., the markers shall be coloured, flat (saddle-style) semi-rigid vinyl plastic with two rows of wording and installed using nylon tie wraps provided with the marker or approved alternative. Alternatively, use coloured pressure sensitive adhesive-style acrylic markers installed with vinyl banding tape.

.3 Stencilled lettering (black Franklin Gothic) identification and directional arrows for normal flow shall be applied by each colour band.

.4 The lettering and arrow size shall be as indicated below:

Pipe Size (mm)	**Letter Height (mm)**	**Arrow Height x Arrow Length (mm x mm)**
Greater than 65	50	50 x 150
30 to 65	25	25 x 100
Smaller than 30	12	12 x 50

.5 Pipe markers and direction arrows shall be suitable for continuous operating temperatures between -40°and 122°C.

.5 Standard Pipe Identification Wording and Colours: Identification wording and colours for pipe identification materials shall be as follows:

Legend	**Colour**	**Symbol**
Potable Cold Water	White/Green	DCW
Potable Hot Water	White/Green	DHW
Potable Hot Water Return	White/Green	DHWR
Tempered Potable Water	White/Green	TW
Storm Drainage	White/Green	ST
Sanitary Drainage	White/Green	SAN
Plumbing Vent	White/Green	VENT
Natural Gas	Black/Yellow	NG
Natural Gas Vent	Black/Yellow	NG VENT
Fuel Oil Supply	Black/Yellow	FOS
Fuel Oil Return	Black/Yellow	FOR
Fuel Oil Vent	Black/Yellow	FO VENT
Heating Water Supply	Black/Yellow	HWS
Heating Water Return	Black/Yellow	HWR
Glycol Heating Water Supply	Black/Yellow	GHWS
Glycol Heating Water Return	Black/Yellow	GHWR
Steam (Humidifier)	Black/Yellow	STEAM
Chilled Water Supply	White/Green	CHWS
Chilled Water Return	White/Green	CHWR

Glycol Chilled Water Supply	White/Green	GCHWS
Glycol Chilled Water Return	White/Green	GCHWR
Compressed Air	Black/Yellow	CA
Pressure Washer	Black/Yellow	PW

.6 Identification Material Manufacturers: Acceptable manufacturers of identification materials shall be equivalent to SMS “Coil-Mark” or SMS “Building Service Pipe Markers” complete with SMS “Banding Tape” pipe markers:

.1 Smillie McAdams Summerlin (SMS) Ltd.

.2 Brady Worldwide Inc.

.3 Revere-Seton Inc.

.4 Embree Industries Ltd.Execution

2.2 EQUIPMENT IDENTIFICATION

.1 Equipment Nameplates: Minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, white background – black lettering, minimum 12 mm x 50 mm (½" x 2") for smaller items such as damper motors and control valves, minimum 25 mm x 65 mm (1" x 2 ½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Each nameplate shall be complete with bevelled edges and engraved wording to completely identify the equipment with no abbreviations. Wording shall generally be in accordance with the Drawings but must be reviewed by the Contract Administrator prior to engraving. Supply stainless steel screws for securing nameplates in place.

.2 Valve Tags: Coloured, 40 mm (1½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match the piping classification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording. For example:

VALVE V12
200 mm
CHILL. WATER
NORMALLY OPEN

2.3 DUCT IDENTIFICATION

.1 Custom made Mylar stencils with 50 mm (2") high lettering to accurately describe the duct service, i.e. “AHU-1 SUPPLY”, complete with a directional arrow, and coloured inks with ink pads and roller applicators. Ink colours shall contrast with the lettering background.

.2 Paint: CAN/CGSB-1.60-M in colours specified in the Contract Documents. Non-specified colours to conform to CAN/CGSB-24.3.

.3 Letters shall be 50 mm high and directional flow arrows shall be 150 mm long stenciled with specified paint with the following wording:

.1 SUPPLY AIR

.2 RETURN AIR

.3 EXHAUST AIR

.4 TRANSFER AIR

.5 COMBUSTION AIR

3 Execution

3.1 INSTALLATION OF MECHANICAL IDENTIFICATION

.1 Exposed Piping and Ductwork: Identify exposed piping and ductwork in accordance with Part 2 of this Section in the following locations:

.1 At every end of every piping or duct run.

.2 Adjacent to each valve, strainer, damper and similar accessory.

.3 At each piece of connecting equipment.

.4 At every change of direction (when another marker is not clearly visible).

.5 On both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise specified in the Contract Documents.

.6 At 10 m (30') intervals on pipe and duct runs exceeding 10 m (30') in length.

.7 On each side of special valves, special fittings and branch connections.

.8 At least once in each room and at least once on pipe and duct runs less than 10 m (30') in length.

.2 Concealed Piping and Ductwork: Identify concealed piping and ductwork in accordance with Part 2 of this Section in the following locations:

.1 At points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas.

.2 At maximum 10 m (30') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room.

.3 At each access door location.

.4 At each piece of connected equipment, automatic valve, etc.

.3 Equipment: Provide an identification nameplate for each piece of equipment, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate all nameplates in the most conspicuous and readable location.

.4 Electrical Tracing: For all electrically traced mechanical Work, identification wording shall include the phrase “ELECTRICALLY TRACED”.

.5 Valve Tagging and Chart: Tag valves and prepare a valve tag chart in accordance with the following requirements:

.1 Attach a valve tag to each new valve, except for valves located immediately at the equipment they control.

.2 Prepare a typed or computer printed valve tag chart to list all tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed).

.3 Frame and glaze one copy of the chart and affix the same to a wall where later directed at the site.

.4 Include a copy of the valve tag chart in each copy of the O&M instructions.

.6 Ceiling Tacks or Stickers: Where shut-off valves, control dampers, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in the ceiling panel material, or stickers on the ceiling grid material to indicate locations of the items. Confirm colours prior to installation.

END OF SECTION

1 General

1.1 SUMMARY

.1 TAB means testing, adjusting and balancing equipment to ensure performance in accordance with requirements of Contract Documents and to perform all other work as specified in this section.

.2 Standard: TAB shall be performed in accordance with the most stringent of TAB standards of AABC, NEBB, SMACNA and ASHRAE.

.3 Perform TAB of all systems, equipment, components, controls specified in the Mechanical Division.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements

.2 Section 23 30 00 – HVAC Ducts and Plenums

.3 Section 25 50 00 – Building Automation System (BAS).

.4 Section 25 00 95 – Sequence of Operation

.5 Section 01 91 00 – General Commissioning Requirements

.6 Section 22 08 00 – Commissioning of Plumbing

.7 Section 23 08 00 – Commissioning of HVAC

.8 Section 23 52 16.10 – Commissioning of Boiler and Interconnected pressure piping

.9 Section 25 08 00 – Commissioning of Integrated Automation

1.3 REFERNCE STANDARDS

.1 National Standards for Total System Balance (AABC)

.2 American Society of Heating Refrigerating, and Air Conditioning Engineers (ASHRAE)

.3 National Building Comfort Testing Association (NBCTA)

.4 National Environmental Building Bureau (NEBB)

.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.6 National Building Code 2020

1.4 THE TAB CONTRACTOR

.1 The Contractor in consultation with the Contract Administrator shall appoint a TAB Contractor to measure and report TAB results to the Contract Administrator. The Contractor shall submit a proposal to the Contract Administrator for assessment before any selection of the TAB Contractor is made. The proposal shall include:

.1 Experience in projects of this size.

.2 Labour costs per hour plus a maximum upset limit.

.3 Personnel to be used.

.4 Equipment to be used for the testing and balancing of the systems.

.5 Test procedures and methods.

.6 Any other items requested.

.2 Names of all personnel proposed to perform TAB shall be submitted to and approved by the Contract Administrator within 90 days of the award of the contract.

.3 Qualifications: Personnel performing TAB shall be current member in good standing of AABC, NEBB, or NBCTA.

1.5 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Pre-mobilization

.1 Submit to the Contract Administrator, prior to the commencement of TAB, the following:

.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

.2 Proposed check lists and report forms.

.3 Preliminary TAB Report

.1 Submit for checking and approval of the Contract Administrator, prior to submission of formal TAB report, sample of rough TAB sheets. Include the following:

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 Summaries.

.4 Tab Report

.1 TAB report shall show all results in SI units and shall include:

.1 Tabulated data from air and piping system measurements; see Article 3.5 and 3.6.

.2 Project record drawings used to show testing locations.

.3 System schematics.

.2 Submit electronic copy of the initial TAB Report to the Contract Administrator for verification and approval, if requested submit one paper copy complete with index tabs.

.3 Provide three copies of the final TAB report. Reports shall be complete with index pages and index tabs, and certified by the TAB Contractor. Any diagram as single line representation of a Mechanical System specifically prepared for this project shall be prepared using a CAD system and shall be acceptable to the Contract Administrator.

1.6 QUALITY ASSURANCE

.1 The work specified in this section shall be performed by an Independent Agency specializing in this type of work.

.2 Balancing (of both air and piping systems) and sound level readings shall be performed by the same agency.

.3 Balancing procedures shall be in accordance with the latest, current requirements of “National Environmental Balancing Bureau” (NEBB) or “Associated Air Balance Council” (AABC), including the following:

.1 NEBB Procedural Standards For Whole Building Systems Commissioning Of New Construction;

.2 NEBB Procedural Standards For Testing Adjusting And Balancing Of Environmental Systems;

.3 NEBB Procedural Standards For Retro- Commissioning Of Existing Buildings;

.4 AABC National Standards for Total System Balance;

.5 AABC Test and Balance Procedures;

.4 TAB of systems and equipment regulated by codes, and/or standards shall be tested and balanced to the satisfaction of the National Building Code.

1.7 SCOPE OF TAB

.1 The following systems shall be tested, adjusted, and balanced:

.1 Air conditioning, ventilation and heating systems

.2 Air distribution (supply, return, exhaust, transfer….etc.)

.3 Miscellaneous ventilation or exhaust systems

.4 Chillers and chilled water distribution (includes glycol system)

.5 Boilers and heating water distribution (includes glycol system)

.6 Plumbing systems

.7 All process systems including natural gas, oil, diesel, fuel, vehicle fluids, vacuum, tail pipe exhaust, compressed air, etc.

2 Products - NOT USED

3 Execution

3.1 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.

.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with all other related systems under all normal and emergency loads and operating conditions.

.3 Testing, adjusting and balancing of the complete systems is to be performed over the entire operating range of each system in accordance with the most stringent requirements of the AABC National Standards for Total System Balance or the NEBB Procedural Standards For Testing, Adjusting, Balancing Of Environmental Systems in order to obtain optimum systems performance. Report all values back to Contract Administrator.

3.2 COORDINATION

.1 The testing and balancing agency is to:

.1 As soon as possible after award of Contract, the testing and balancing agency is to carefully examine a set of mechanical Drawings with respect to routing of services and location of balancing devices, and is to report the results of the evaluation to the Commissioning Agent, with a copy of the report to be sent to the Contract Administrator.

.2 The set of Drawings examined by the agency is to be returned to the Contract Administrator with the evaluation report, marked-up to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices.

.3 After careful review of the mechanical work Drawings and Specifications, the testing and balancing agency is to visit the site at frequent, regular intervals with the Commissioning Agent, during construction of the mechanical systems, to observe routing of services, locations of testing and balancing devices, workmanship, and anything else that will affect testing, adjusting and balancing.

.4 After each site visit, the agency is to report results of the site visit to the Commissioning Agent, with a copy of the report to be sent to the Contract Administrator, indicating the date and time of the visit, and detailed recommendations for any corrective work required to ensure proper adjusting and balancing.

.2 Testing, adjusting and balancing Work is not to begin until:

.1 Building construction Work is substantially complete.

.2 Mechanical systems are complete in all respects, and have been checked, started, adjusted, and then performance tested in the presence of and to the satisfaction of the Commissioning Agent.

.3 Schedule time required for TAB (including repairs, re-testing) into the Work construction and completion schedule so as to ensure completion prior to the acceptance of project.

.4 Perform TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

.5 The TAB Contractor shall co-ordinate with the Contractor to ensure that all necessary control and balancing valves (water-side) as well as manual and splitter dampers (air-side) for balancing are installed in all locations required. Notify the Contract Administrator in writing that this co-ordination has taken place. Include in this letter any recommendations made regarding valves, dampers, locations, installation, etc. If this TAB Contractor fails to co-ordinate with the Contractor and if failure to co-ordinate results in being unable to balance the systems, the cost of any changes required shall be paid for by the TAB Contractor at no cost to the City.

.6 The TAB Contractor shall not disconnect any control device. Command control devices and enter adjusted set points into the building automation system with tools and training that are furnished under Section 25 50 00 – Building Automation System (BAS). If the TAB Contractor fails to co-ordinate with Section 25 50 00 – Building Automation System (BAS) and if failure to co-ordinate results in any cost, the cost of any change required shall be paid by the TAB Contractor at no cost to the City.

.7 The Contractor will provide new filters, etc. required for the measurements taken by the TAB Contractor.

.8 The Contractor shall provide copies of all Shop Drawings requested by the TAB Contractor.

.9 The Contractor shall make staff available, as required by the TAB Contractor, to operate the equipment to take measurements and to correct any deficiencies in the mechanical systems which prevent the TAB Contractor from balancing the system.

.10 The Contractor shall ensure access is provided to all valves, dampers, fire dampers, and other equipment that requires servicing.

.11 The Contractor shall confirm Start-Up and Operation of Equipment for the TAB Contractor:

.1 Follow start-up procedures as recommended by the equipment manufacturer unless specified otherwise in the Contract Documents.

.2 Follow special start-up procedures specified in the Mechanical Division

.3 Operate systems for length of time required for TAB and as required by the Contract Administrator for verification of TAB reports.

.4 Coordinate with Commissioning Agent as required.

3.3 TESTING, ADJUSTING, AND BALANCING

.1 The TAB Contractor is responsible for balancing the systems to obtain the design conditions and shall repeat the balancing until the required conditions have been met.

.2 The TAB Contractor shall balance all air systems to ensure all fans, air handling equipment, VAVs, FCUs, and AHUs are operating to design conditions. Adjust air volumes and control settings under maximum system pressure drop conditions by means of balancing dampers and record balance position.

.3 The TAB Contractor shall balance all piping systems to ensure all boilers, chillers, pumps, heat exchangers, AHUs, FCUs, cabinet/unit/other heaters, domestic hot water balancing valves, process and industrial systems, etc., are operating to design conditions. Adjust the circuits by means of the balancing valves and record balance position.

.4 The TAB Contractor is to balance all systems with due regard to objectionable noise which is to be a factor when adjusting fan speeds and performing terminal work such as adjusting grille and diffuser air quantities, and should objectionable noise occur at the design conditions, the agency is to immediately report the problem to the Commissioning Agent and the Contract Administrator and submit data, including sound readings, o permit an accurate assessment of the noise problem to be made.

.5 The TAB Contractor is to check all air handling system mixing plenums for stratification, and where the variation of mixed air temperature across coils is found to be in excess of plus or minus 10 percent of design requirements, the agency is to report to the Commissioning Agent and the Contract Administrator and issue a detail sketch of plenum baffle(s) required to eliminate the stratification.

.6 The TAB Contractor is to provide and install new sheaves and belts required for final air balance.

.7 The TAB Contractor is to provide and install instrument test ports in all main ducts at connections to fans, plenums or casings, in all larger branch duct connections to mains, and wherever else required for proper air quantity balancing and testing.

.8 Wherever possible, the agency is to lock all balancing devices in place at the proper setting, and permanently mark settings on all devices.

.9 Pre-Tab Review:

.1 Review contract documents prior to the commencement of the Work and confirm in writing to the Contract Administrator adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.

.2 If testing procedures are to deviate from the specified standards provide the Contract Administrator with all proposed procedures for acceptance.

.3 During construction, co-ordinate location and installation of all TAB devices, equipment, accessories, measurement ports and fittings.

.10 Instruments:

.1 Prior to TAB work, submit to the Contract Administrator a list of instruments to be used for TAB together with serial numbers.

.2 Calibrate the instruments in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate the instruments within 3 months of the performance of TAB work. Provide certification of calibration to the Contract Administrator.

.11 Tolerances:

.1 Perform TAB in accordance with the following application tolerances of design information:

.1 Piping systems: Plus or minus 10%.

.2 Air systems: Plus or minus 5%.

.2 Accuracy of measured values shall be accurate to within plus or minus 2% of actual values.

.12 Start-up of TAB:

.1 Notify the Commissioning Agent and the Contract Administrator seven (7) days prior to start of TAB.

.2 Start TAB only when the building is essentially completed, including the following components:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.

.2 Application of weather stripping, sealing, caulking.

.3 All pressure, leakage, other tests specified elsewhere; Division 22, 23, 25.

.4 All provisions and components for TAB installed and operational.

.5 Start-up and verification of proper, normal and safe operation of all mechanical systems and associated electrical/control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Duct access doors installed, closed.

.8 All outlets installed, volume control dampers open.

.3 Piping systems:

.1 Flushed, filled and vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolation, check, and control valves installed, open.

.5 Calibrated balancing valves installed, at factory settings.

.6 Chemical treatment systems complete, operational.

.3 The TAB Contractor shall balance the air and piping systems as described in Articles 3.5 and 3.6 of this Section. TAB Contractor shall submit an initial TAB Report for Verification.

.13 Verification:

.1 After initial balancing all reported results are subject to verification by the Contract Administrator.

.2 In all cases where measurements by the TAB Contractor show failure to comply with the Drawings and Specifications, the Contractor shall change fan sheaves, etc., as required, and new balancing measurements shall be made by the TAB Contractor.

.3 At the time of final review, recheck in the presence of the Contract Administrator random selections of air quantities and fan data recorded in the certified report. Points or areas for recheck shall be selected by the Contract Administrator and be approximately 10% of the report data.

.4 At the time of verification measure space temperature and humidity in a representative number of rooms to verify performance. Tabulate these results and bind into certified report as an appendix.

.5 Number and location of verified results shall be at the discretion of the Contract Administrator. A measured flow deviation of more than 10% between the verification reading and the reported data shall be considered as failing the verification procedure.

.6 Bear costs to repeat TAB and submit new certified reports as required to the satisfaction of the Contract Administrator.

.14 Completion of TAB:

.1 TAB shall be considered complete when the final TAB Report is received and approved by the Contract Administrator.

.2 After TAB is competed to satisfaction of the Contract Administrator, replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings.

.3 Following final acceptance of the certified reports by the Contract Administrator, permanently mark the settings of all valves, dampers, splitters and other adjustable devices so that balance set position can be restored if disturbed at any time. Do not mark such devices until after final acceptance.

.4 Ensure all thermostats and controls are set to give specified conditions and include settings is report.

.5 When testing, adjusting, and balancing work is complete and the balancing report has been accepted, the TAB Agent is to submit to the City, a written extended warranty covering one full heating season and one full cooling season, during which time any balancing problems which occur in the buildings, with the exception of minor revision work done during scheduled site visits, will, at no cost, be investigated by the TAB Agent and reported on to the City, and if it is determined that the problems are a result of improper testing, adjusting and balancing, they are to be immediately corrected without additional cost to the City.

.6 After completion of testing, adjusting and balancing work and acceptance of the report, the testing and balancing agency and the is to make the following follow-up site visits:

.1 Once during the first month of building operation.

.2 Once during the third month of building operation.

.3 Once between the fourth and tenth months in a season opposite to the first and third month visit.

.4 Once in first and third months and once between the fourth and tenth months in a season opposite to the first and third month visit for the second consequent year of building operation.

.7 During each return visit and accompanied by the City's representative, the testing and balancing agency is to spot rebalance terminal units as required to suit building occupants and eliminate complaints.

.8 The TAB Agent is to schedule each visit with the City, and inform the Contract Administrator.

.9 After each follow-up site visit, the TAB Agent is to issue to the City and Contract Administrator a report indicating any corrective work performed during the visit, all abnormal conditions and complaints encountered, and recommended corrective action.

3.4 AIR SYSTEMS TESTING BY TAB CONTRACTOR

.1 Measurements: shall include, but not be limited to the following as appropriate for systems, equipment, components, controls:

.1 Air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dew point), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.2 Locations of equipment measurements shall include, but not be limited to the following as appropriate:

.1 Inlet and outlet of each damper, filter, heat exchanger, coil, humidifier, fan, other equipment causing changes in conditions, at each controller, controlled devices.

.3 Locations of systems measurements shall include, but not be limited to following as appropriate:

.1 Each main duct, main branch, sub-branch, or run-out (or grille, register or diffuser), all other auxiliary equipment, all areas served by the system.

.4 Duct traverse readings shall be taken through the access ports provided. Where no access ports have been provided new holes shall be made as required. These holes shall be resealed after final readings with sheet metal cover plates and sealant. Duct tape is not acceptable. Where insulation is damaged it shall be repaired including the vapour barrier in an approved manner. Duct tape is not acceptable.

.5 Fans on all systems shall be set up to give the minimum discharge pressure required to overcome the resistance of the box, discharge ductwork and diffusers.

.6 Air handling systems that include filters are to be balanced simulating air filters at a dirty state as follows:

.1 pre-filter only – 250 Pa (1 inch wg)

.2 pre-filter & final filter combination - 400 Pa (1.6 inch wg)

3.5 PIPING SYSTEMS TESTING BY TAB CONTRACTOR

.1 Measurements: shall include, but not be limited to the following as appropriate for systems, equipment, components, controls:

.1 Liquid velocity, pressure, flow rate, pressure drop (or loss), temperatures, RPM, electrical power, voltage, noise, vibration.

.2 Locations of equipment measurements shall include, but not be limited to following as appropriate:

.1 Inlet and outlet of each heater, tank, pump, circulator, at each controller, controlled device, or fixture. (Includes both hydronic, plumbing systems and process and industrial systems)

.3 Locations of systems measurements shall include, but not be limited to following as appropriate:

.1 Each main, main branch, branch, or sub-branch.

.4 Flow through all coils, heat exchangers, chillers, boilers and other such equipment shall be balanced to ensure that the pressure drop through the equipment is within 10% of the manufacturer's design conditions.

.5 If the design conditions cannot be met by adjusting the balancing valves throughout the system, or by the adjusted the VFD settings, then pump impellers shall be either changed or trimmed as required.

.6 Heat transfer system measurements for:

- .1 flow
- .2 pressure
- .3 temperature
- .4 specific gravity
- .5 RPM
- .6 electrical power current draw and voltage

.7 Heat transfer system location of equipment measurements at the inlet and outlet of each:

- .1 coil
- .2 circulating pump
- .3 pressure reducing valve
- .4 other auxiliary equipment

.8 Heat transfer system location of system measurements at the supply and return of each primary and secondary loop of each system.

.9 Potable hot water recirculation systems location of equipment measurement for the inlet and outlet of each tank, heater and pump, and location of system measurements at each piping main, branch main, branch, and sub-branch.

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section covers the selection and installation of plumbing, process and industrial and building mechanical piping insulation as well as the selection and installation of ductwork insulation unless additional requirements have been detailed elsewhere in the Contract Documents.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 20 05 29 – Hangers and Supports.

.3 Section 22 11 16 – Domestic Water Piping.

.4 Section 22 13 16 – Drainage, Waste and Vent Piping.

.5 Section 23 30 00 – HVAC Ducts and Plenums.

.6 Section 23 21 13 – Hydronic Piping.

1.3 REFERENCE STANDARDS

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International, (ASTM)

.1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).

.2 C165: Standard Test Method for Measuring Compressive Properties of Thermal Insulations

.3 ASTM C 177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

.4 ASTM C 240, Standard Test Methods of Testing Cellular Glass Insulation Block.

.5 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.6 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.7 ASTM C 449, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.8 ASTM C 547, Specification for Mineral Fiber Pipe Insulation.

.9 ASTM C 553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.10 ASTM C 612, Specification for Mineral Fiber Block and Board Thermal Insulation.

.11 ASTM C 795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.

.12 ASTM C 921, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.13 ASTM E 96 / E 96M, Standard Test Methods for Water Vapor Transmission of Materials.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 International Organization for Standardization (ISO)

.1 ISO-6944, Duct 'A' Standard with 1 or 2-Hour External Duct Fire Rating.

.5 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.6 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S102.2, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

.3 CAN/ULC-S144, Standard Method of Fire Resistance Test – Grease Duct Assemblies.

.4 CAN/ULC-S700 Series Standards for insulation material.

.7 National Building Code 2020 (NBC)

1.4 DEFINITIONS

.1 For purposes of this Section:

.1 "CONCEALED" means insulated mechanical services and equipment in suspended ceilings (inclusive of tile ceilings) and non-accessible chases and furred-in spaces.

.2 "EXPOSED" means "not concealed" as defined in this Section.

.3 Insulation systems shall mean insulation material, fasteners, jackets, and other accessories.

1.5 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings:

.1 Submit a set of shop drawings identifying each product with the manufacturer's name and insulation type, and the proposed use of the insulation. Include a product data sheet for each insulation type.

.2 Include shop drawings of all insulation jacket materials, each identified as to its intended use, and product data sheets for the protective coatings.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 – Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 FIRE HAZARD RATINGS

.1 All insulation materials shall meet the requirements of CAN/ULC-S700 Series Standards.

.2 Unless otherwise specified in the Contract Documents, all insulation system materials inside the building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with CAN/ULC-S102.

2.2 PIPE INSULATION MATERIALS

.1 Flexible Elastomeric Foam: Closed cell, tubular foamed plastic pipe insulation with a "k" factor of 0.039 W/m°C (0.27 BTU/hr*ft*°F) when tested in accordance with ASTM C177 or ASTM C518 at mean temperature 24°C (75°F), 25/50 flame spread/smoke developed rated, with a water vapour transmission rating of 0.08 in accordance with ASTM E 96, Procedure A, and all required installation accessories. Acceptable products are:

.1 Armacell LLC "AP Armaflex 25/50" with "Armafix" insulation pipe hangers (IPH) or ZSi-Foster "Cush-A-Therm" clamps.

.2 Closed Cell Foamed Glass: Pittsburgh-Corning "FOAMGLASS", expanded, sectional, rigid sleeve type insulation with a liquid or vapour permeability rating (in accordance with ASTM C240) of 0.00, and a factory applied "PITTWRAP SSII" self-sealing jacket secured with, when required. "PITTWRAP SS" primer and PC88 adhesive.

.3 Preformed Calcium Silicate: Rigid, sectional sleeve type insulation in accordance with ASTM C533 with a "k" factor of 0.079 W/m°C (0.55 BTU/hr*ft*°F). Acceptable products are:

.1 Johns Manville Inc. "Thermo-12 Gold"

.2 Calsilite Group (Industrial Insulation Group LLC) Ruston "GOLD"

.4 Calcium Silicate 3-V scored sheets boards or flat boards: Rigid, sectional type insulation in accordance with ASTM C533 with a "k" factor of 0.078 W/m°C (0.54 BTU/hr*ft*°F). Acceptable products are:

.1 Johns Manville Inc. "Super Caltemp Gold 1700"

.2 Or approved equivalent

.5 Fire Rated Preformed Fibreglass: Non-Combustible, fire rated, hollow cylindrical heavy density (min 7 pcf or 112 kg/m3) fibreglass units with an all service jacket. Longitudinal joints sealed with metal fasteners or factory-applied self-sealing lap tape. Transverse joints secured with metal fasteners or with butt tape supplied with the product. Pipe covering material as listed as a firestop component in cUL/ULC listed firestop systems, C-AJ-1366, C-AJ-1066, W-J-1127, C-AJ-5125, and C-AJ-8075.

.6 Preformed Fibreglass: Rigid, sectional, sleeve type insulation with a "k" factor of 0.033W/m°C (0.23 @ 75°F) when tested in accordance with ASTM C335 (Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation), and a factory applied vapour retarding jacket (.02 perm). Acceptable products are:

.1 Johns Manville Inc. "Micro-Lok H" with "ASJ-SSL jacket

.2 Knauf Insulation Ltd. Earthwool 1000° with ASJ/SSL Pipe Insulation

.3 Manson Insulation Products Ltd. "ALLEY K" with "ASJ-SSL" jacket

.7 Blanket Fibreglass: Blanket type roll insulation, 24 kg/m3 (1.5 lb/ft3) density, with installed "R" value of 0.83 m2 °C/W (4.7 BTU/hr*ft*°F, and a factory applied vapour barrier facing. Acceptable products are:

.1 Johns Manville Inc. Type 150 "Microlite"

.2 Knauf Insulation Ltd. Fiber Glass Blanket Insulation with multi-purpose "FSK" facing

.3 Manson Insulation Products Ltd. "ALLEY WRAP FSK"

.8 High-Temp Blanket Fibreglass: Blanket type roll insulation, rated for a continuous use temperature of 1050°C (1920°F), 64 kg/m^3 (4 lb/ft^3) density, with a thermal conductivity of 0.35 W/(m*°K) (0.94 BTU*in/(hr*ft^2*°F)) at 538°C (1000°F). Acceptable products are:

.1 Morgan Advanced Materials “Superwool® Plus Blanket”

.9 Phenolic Foam: Belform Insulation Ltd. (519-652-5190) "Insulphen" rigid, 32 kg/m3 (2 lb/ft3) density, closed cell sectional pipe insulation and factory fabricated shapes for fittings, with a R Value of 7.7 for 25 mm (1 in.) thick insulation and a factory applied FSK vapour barrier jacket.

.10 Pipe Insulation at Hangers and Supports: Coordinate with discipline responsible for Section 20 05 29 – Hangers and Supports to provide thermal breaks as listed here and in section 2.9 of that specification. Insulation shall be a 300 mm (12 in.) long piece of sectional pipe insulation with a thickness equal to the adjacent insulation, a foil and glass reinforced kraft paper vapour barrier jacket, and a minimum 0.80 mm thick (22 ga) G60 galvanized steel shield the same length as the insulation. The insulation shall be:

.1 Johns Manville Inc. "Thermo-12 Gold" or Calsilite Group Ruston "GOLD" rigid calcium silicate

.2 Belform Insulation Ltd. 60 kg/m3 (3.75 lb./ft3) density "Insulphen" closed cell phenolic foam

2.3 WHEELCHAIR LAVATORY PIPING INSULATION KITS

.1 Removable, flexible, reusable, white moulded plastic insulation kits for a wheelchair lavatory drain piping and potable water supplies exposed under the lavatory. Acceptable products are:

.1 Plumberex Specialty Products Inc. "Pro-2000" Series

.2 Truebo Inc. "Handi Lav-Guard"

.3 TCI Products Inc. "SKAL-GARD"

.4 John Manville Inc. Zeston "SNAP-TRAP"

2.4 EQUIPMENT INSULATION MATERIALS

.1 Blanket Fibreglass: Blanket type roll form insulation, 24 kg/m3 (1.5 lb/ft3) density, with a "k" factor (compressed thickness) of 0.035 W/m°C (0.24 BTU/hr*ft*°F), with a factory applied vapour barrier facing. Acceptable products are:

.1 Johns Manville Inc. Type 150 "Microlite"

.2 Knauf Insulation Ltd. Friendly Feel Duct Wrap with KwikStretch Markings with multi-purpose "FSK" facing

.3 Manson Insulation Products Ltd. "ALLEY WRAP FSK"

.2 High-Temp Blanket Fibreglass: Blanket type roll insulation, rated for a continuous use temperature of 1050°C (1920°F), 64 kg/m^3 (4 lb/ft^3) density, with a thermal conductivity of 0.35 W/(m*°K) (0.94 BTU*in/(hr*ft^2*°F)) at 538°C (1000°F). Acceptable products are:

.1 Morgan Advanced Materials “Superwool® Plus Blanket”

.3 Semi-Rigid Fibreglass Board: Roll form, moulded insulation, 48.1 kg/m3 (3.0 lb/ft3) density, with a "k" factor of 0.033 W/m°C (0.23 BTU/hr*ft*°F), with a factory applied vapour barrier facing consisting of laminated aluminum foil and kraft paper. Acceptable products are:

.1 Johns Manville Inc. "Pipe and Equipment Insulation"

.2 Knauf Insulation Ltd. Fiber Glass Pipe and Tank Insulation or KwikFlex Pipe & Tank Insulation

.3 Manson Insulation Inc. "AK FLEX"

.4 CertainTeed “CertaPro Commercial Board”

.4 Preformed Calcium Silicate: Rigid block and/or semi-rigid factory scored block insulation. Acceptable products are:

.1 Johns Manville Inc. "Thermo-12 Gold"

.2 Calsilite Group (Industrial Insulation Group LLC) Ruston "GOLD"

.5 Closed Cell Foamed Glass: Pittsburgh Corning "FOAMGLAS" expanded, rigid board and bock type insulation with a liquid or vapour permeability rating (in accordance with ASTM C240) of 0.00.

2.5 DUCTWORK SYSTEM INSULATION MATERIALS

.1 Rigid Fibreglass Board: Preformed board type insulation, 48.1 kg/m3 (3.0 lb/ft3) density, with a "k" factor of 0.033 W/m°C (0.23 BTU/hr*ft*°F @ 75°F mean), with a factory applied reinforced aluminum foil and kraft paper facing. Acceptable products are:

.1 Johns Manville Inc. Type 814 "Spin-Glas"

.2 Knauf Insulation Ltd. Fiber Glass Insulation Board with FSK facing

.3 Manson Insulation Products Ltd. "AK BOARD FSK"

.2 Blanket Fibreglass: Blanket type roll form insulation, 24 kg/m3 (1.5 lb/ft3) density, 40mm (1.5 in.) thick, with a factory applied vapour barrier facing. Acceptable products are:

.1 Johns Manville Inc. Duct Wrap Type 150 "Microlite"

.2 Knauf Insulation Ltd. Friendly Feel Duct Wrap with KwikStretch Markings with multi-purpose "FSK" facing

.3 Manson Insulation Products Ltd. "ALLEY WRAP FSK"

.3 High-Temp Blanket Fibreglass: Blanket type roll insulation, rated for a continuous use temperature of 1050°C (1920°F), 64 kg/m^3 (4 lb/ft^3) density, with a thermal conductivity of 0.35 W/(m*°K) (0.94 BTU*in/(hr*ft^2*°F)) at 538°C (1000°F). Acceptable products are:

.1 Morgan Advanced Materials “Superwool® Plus Blanket”

.4 Preformed Calcium Silicate: Rigid block and sheet insulation. Acceptable products are:

.1 Johns Manville Inc. "Thermo-12 Gold"

.2 Calsilite Group (Industrial Insulation Group LLC) Ruston "GOLD"

.5 Flexible Elastomeric Foam Sheet: Sheet form, closed cell foamed plastic insulation with a "k" factor of 0.039 W/m°C (0.27 BTU/hr*ft*°F) at mean temp 24°C (75°F) per ASTM C177, 25/50 flame spread/smoke developed rated, with a water vapour transmission rating of 0.08 in accordance with ASTM E 96, Procedure A, and all required installation accessories. Acceptable products are:

.1 Armacell LLC "AP Armaflex 25/50" Sheet & Roll

2.6 FIRE RATED DUCT WRAP

.1 Fire resistant duct insulation shall be a flexible high temperature insulation rated for a continuous use limit of 1000ºC (1832ºF). The insulation shall be blanket type fibreglass duct wrap completely encapsulated in reinforced foil with a nominal thickness of 40 mm (1.5 in.) thick, density of 96 kg/m3 (6 lbs/ft3) and R-Value of 7.3 at 23.9°C (75°F). The duct enclosure system shall be suitable for installation with zero clearance to combustibles with a 2-hour fire resistance rating for grease ductwork in accordance with the requirements of CAN/ULC S144. Product shall meet flame spread rating of 25 and smoke developed rating of 50 as per CAN/ULC S102.2. Insulation product shall be complete with all manufacturers standard fastenings, including (where applicable) aluminum foil tape, filament tape, banding materials, pins, cup-head weld pins, and speed clips for a ULC listed installation.

.2 Acceptable Manufactures:

.1 CL4 Inc. "CL4Fire"

.2 3M Canada Inc. “Fire Barrier Duct Wrap 615+”

.3 Morgan Advanced Materials “FireMaster Fastwrap”

2.7 ACOUSTIC LAGGING

.1 Where indicated on the Contract Drawings, wrap duct or unit casing outside with composite mass lagging with decoupling layer.

.2 The acoustic lagging shall comprise a foil-faced mass loaded, limp vinyl sheet barrier, with density 9.6-kg/m2 (2.0-psf), and light density fibreglass decoupling layer with minimum thickness 25 mm (1”) to separate the wall of the duct or unit casing from the exterior barrier cladding.

.3 Acoustic lagging shall have surface burning characteristics as follows: Flame Spread Index: 25 or less, and Smoke Development Index: 50 or less, per CAN/ULC S102.2. Acoustic lagging shall be tested with reinforced foil scrim face exposed to flame. Relevant local building and fire codes should always be referenced for the suitability of materials used.

.4 Acceptable manufacturers are:

.1 Kinetics Noise Control, Inc.

.2 AcoustiGuard Wilrep Ltd.

.3 BRD Noise and Vibration Control Inc.

2.8 INSULATION FASTENINGS

.1 Wire: Minimum 1.8 mm diameter (15 ga) galvanized annealed wire.

.2 Stainless Steel Banding: Childers Products Co. "FABSTAPS" 0.6 mm (24 ga) Type 304 minimum 12 mm (0.5 in.) wide stainless steel strapping or approved equivalent.

.3 Duct Insulation Fasteners: Weld-on 2 mm (12 ga) zinc coated steel spindles of suitable length, complete with minimum 40 mm (1.5 in.) square plastic or zinc plated steel self-locking washers.

.4 Tape Sealant: 3M™ Venture Tape™ 1525CW, 3M™ Venture Tape™ 1520CW, 3M™ FSK Silver (foil) Facing Tape, 3M™ FSK Facing Tape or approved equivalent self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match the surface being sealed. CAN/ULC S102 listed (10/10 flame/smoke rating)

.5 Adhesive - Fibreglass Insulation: Clear, pressure sensitive, quick setting brush consistency adhesive, non-flammable when wet, fire resistive when dry, suitable for a temperature range of -20°C (-4°F) to 82°C (180°F) and compatible with the type of material to be secured, and Globally Harmonized System of Classification and Labelling of Chemicals (GHS) classified as non-hazardous.

.6 Adhesive – Flexible Elastomeric Insulation: Armstrong World Industries Inc. # 520 air-drying contact adhesive.

.7 Adhesive – Phenolic foam Insulation: As recommended by the insulation manufacturer.

.8 Adhesive – Closed Cell Foamed Glass Insulation: Pittsburgh-Corning PC88 multi-purpose two-component adhesive.

.9 Sheet Metal Screws: No. 10 stainless steel sheet metal screws.

2.9 INSULATION JACKETS AND FINISHES

.1 White PVC Fitting Covers: Factory preformed, one-piece, minimum 15 mil thick white PVC covers, 25/50 rated with a semi-luster finish. Acceptable products are:

.1 Proto Corp. "LoSMOKE"

.2 Foster Products (H.B. Fuller Construction Products Inc.) "SMOKE-SAFE 25/50 SEALFAS"

.3 Speedline Corporation The Sure-Fit System "SMOKE-LESS 25/50"

.4 Johns Manville Inc. "Zeston"

.5 Belform Insulation Ltd.

.2 White Sheet PVC: Roll form (and fitting covers), minimum 15 mil thick white PVC, 25/50 rated, complete with installation and sealing accessories. Acceptable products are:

.1 Proto Corp. "LoSMOKE"

.2 Foster Products (H.B. Fuller Construction Products Inc.) "SMOKE-SAFE 25/50 SEALFAS"

.3 Speedline Corporation The Sure-Fit System "SMOKE-LESS 25/50"

.4 Johns Manville Inc. "Zeston"

.5 Belform Insulation Ltd.

.3 Coloured Sheet PVC: Roll form (and fitting covers), minimum 15 mil thick coloured PVC, 25/50 rated, complete with insulation and sealing accessories. Acceptable products are:

.1 Proto Corp. "LoSMOKE"

.2 Foster Products (H.B. Fuller Construction Products Inc.) "SMOKE-SAFE 25/50 SEALFAS"

.3 Speedline Corporation The Sure Fit System "SMOKE-LESS 25/50"

.4 Johns Manville Inc. "Zeston"

.5 Belform Insulation Ltd.

.4 Aluminum: Smooth aluminum jacket material with a 13 mm (0.5 in.) safety edge in accordance with ASTM B209, 0.6 mm (0.025 in.) thick, factory cut to size and complete with moisture barrier and 50 mm overlap and with stainless steel bands on 300 mm (12 in.) centres. Fittings shall be two piece epoxy coated with silicone joints as required.

.5 Stainless Steel: Smooth type 304 stainless steel jacket material to ASTM A240, 0.4mm (0.016 in.) thick, factory cut to size, complete with moisture barrier and 50 mm overlap and with stainless steel bands on 300 mm (12 in.) centers. Fittings are to be two piece pressed stainless steel with with silicone joints as required.

.6 Adhesive Backed Metal Faced Weather Barrier: Belform Insulation Ltd. "Flex-Clad 400" roll form sheet material with an adhesive backing and an embossed aluminum facing.

.7 Factory Applied Insulation Weather Barrier: Knauf Insulation Ltd. Redi-Klad™ 1,000° pipe insulation, factory applied, five-ply, weather and abuse resistant, 0.0 permeability, embossed aluminum, self-sealing lap pipe insulation jacket. Insulation and jacketing system shall be designed for piping systems operating from -18°C to 538°C (0°F to 1,000°F).

.8 Insulation Cement: Heat resistant, trowel consistency thermal insulating and finishing cement to ASTM C-449/C-449M, and suitable in all respects for the application.

.9 Protective Coating – Foamed Glass Insulation: Pittsburgh Corning Co. "PITTCOTE 404" flexible acrylic latex weather barrier coating, white unless otherwise specified in the Contract.

.10 Protective Coating – Flexible Elastomeric Foam Insulation: Armacell LLC "WB Armaflex" white, water based latex enamel, semi-gloss or approved equivalent.

.11 Factory Applied Jacket - Flexible Elastomeric Foam Insulation: ArmaFlex “Shield”. ArmaFlex insulation with a factory-applied polymeric protective covering designed to prevent damage to the insulation from water ingress, sunlight, installation, and physical abuse.

3 Execution

3.1 GENERAL INSULATION APPLICATION REQUIREMENTS

.1 Unless otherwise specified in the Contract Documents, do not insulate the following:

.1 Factory insulated equipment and piping;

.2 Heating piping within radiation unit enclosures, including blank filler sections of enclosures;

.3 Heating piping in soffits and/or overhang spaces and connected to bare element radiation in the spaces;

.4 Branch potable water piping located under counters to serve counter mounted plumbing fixtures and fittings, except wheelchair lavatories;

.5 Exposed chrome plated potable water angle supplies from concealed piping to plumbing fixtures and fittings, except wheelchair lavatories;

.6 Heated liquid system pump casings, valves, strainers and similar accessories;

.7 Expansion tanks;

.8 Fire protection pump casings;

.9 Heating piping manufactured expansion joints and flexible connections;

.10 Acoustically lined ductwork and/or equipment; and

.11 Flexible ductwork connection material (at expansion joints and vibrating equipment).

.2 Unless otherwise specified or shown in the Contract Documents the installation of piping and ductwork insulation shall be in accordance with the TIAC Mechanical Insulation Best Practices Guide.

.3 Install insulation directly over pipes and ducts and not over hangers and supports. Insulation and covering shall pass unbroken through the hangers and supports.

.4 Do not apply insulation unless leakage tests have been satisfactorily completed.

.5 Ensure that all surfaces to be insulated are clean and dry.

.6 Ensure that the ambient temperature is minimum 13ºC (55ºF) for a minimum of one day prior to the application of insulation, and for the duration of insulation work, and that relative humidity is and will be at a level such that mildew will not form on insulation materials.

.7 Install piping insulation and covering continuous through pipe openings and sleeves.

.8 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.

.9 Pipe insulation at hangers and supports shall consist of a minimum of 300 mm (12 in.) long sections of calcium silicate or phenolic foam sectional insulation with vapour barrier jacket. Coordinate with discipline responsible for Section 20 05 29 – Hangers and Supports to provide thermal breaks as listed here and in section 2.9 of that specification. Galvanized steel shields shall be provided between the insulation and the hanger or support for all pipe 50 mm (2 in.) diameter and above and not requiring a roller hanger or support. Provide "Armafix" insulation pipe hangers (IPH) or ZSi-Foster "Cush-A-Therm" clamps for flexible elastomeric foam insulation.

.10 Where roller hangers and supports are required for "hot" piping 150 mm (6 in.) diameter and larger, steel protection saddles will be provided as part of the Section 20 05 29 – Hangers and Supports work. Pack the saddle voids with fiberglass insulation.

.11 When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect the insulation jacketing from the action of condensation at its junction with the metal. Insulation on cold piping must not be broken. Saddles that touch the cold piping directly are not acceptable on cold piping.

.12 Irregular shaped objects such as strainers, pipe system filters, cyclone separators, blowdown valves and other accessories requiring servicing, on insulated piping, shall be insulated with removable caps or sections. All edges shall be sealed between pipe and vapour barrier and held in place with stainless steel straps. Finish all insulation smooth, making the outline of pipe insulation a true circular and concentric shape. Shape the outline of fitted insulation to blend with adjacent covering.

.13 The final appearance and finish of exposed mechanical Work depends to a large degree on the quality of the insulation application, therefore, a neat and properly finished insulation job will be insisted upon.

.14 When insulating vertical piping risers 75 mm (3 in.) diameter and larger, use insulation support rings welded directly above the lowest pipe fitting, and thereafter at 4.5 m (15 ft.) centres and at each valve and flange. Insulate in accordance with Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.

.15 Where piping and/or equipment is traced with electric heating cable, ensure that the cable has been tested and accepted prior to the application of insulation, and ensure that the cable is not damaged or displaced during the application of insulation.

.16 Where existing insulation work is damaged as a result of a new mechanical work, repair the damaged insulation work to new work standards.

.17 Where fibreglass rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover the exposed end of the insulation with a purpose made PVC cover on "cold" piping.

.18 Carefully and neatly gouge out insulation for proper fit where there is interference between weld bead, mechanical joints, etc., and insulation. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.

.19 Where thermometers, gauges, etc., occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in the insulation and provide a suitable grommet in the opening.

3.2 PIPE INSULATION REQUIREMENTS – FIBREGLASS

.1 Domestic Water: Insulate the following pipe with fibreglass insulation of the thickness noted below:

.1 Potable cold water piping inside building and above ground – 25 mm (1 in.) thick.

.2 Potable hot water piping within. operating water temperatures up to and including 60°C (140°F), size of up to and including 32 mm (1.25 in.) – 25 mm (1 in.) thick.

.3 Potable hot water piping with operating water temperatures up to and including 60°C (140°F), size of 40 mm (1.5in.) and larger – 40 mm (1.5 in.) thick.

.4 Potable hot water piping with operating water temperatures above 60°C (140°F), size of up to and including 32 mm (1.25 in.) - 40 mm (1.5 in.) thick.

.5 Potable hot water piping with operating water temperatures above 60°C (140°F), size of 40 mm (1.5 in.) and larger - 50 mm (2 in.) thick.

.6 Tempered potable water piping, up to and including 32 mm (1.5 in.) - 25 mm (1 in.) thick.

.7 Tempered potable water piping, 40 mm (1.5 in.) and larger - 40 mm (1.5 in.) thick.

.8 Potable hot water recirculation piping with operating water temperatures up to and including 60°C (140°F), size of up to and including 32 mm (1.25 in.) - 25 mm (1 in.) thick.

.9 Potable hot water recirculation with operating water temperatures up to and including 60°C (140°F), size of 40 mm (1.5 in.) and larger - 40 mm (1.5 in.) thick.

.10 Potable hot water recirculation piping with operating water temperatures above 60°C (140°F), size of up to and including 32 mm (1.25 in.) - 40 mm (1.5 in.) thick.

.11 Potable hot water recirculation piping with operating water temperatures above 60°C (140°F), size of 40 mm (1.5 in.) and larger - 50 mm (2 in.) thick.

.12 Non-potable cold water inside building and above ground – 25 mm (1 in.) thick.

.2 Drainage, Waste, and Venting: Insulate the following pipe with fibreglass insulation of the thickness noted below:

.1 Storm drainage piping from roof drains to the point where main vertical risers extend straight down, without offsets, and connect to horizontal mains. Where the roof drain is less than 5000 mm (16 ft.) from the vertical leader, insulate the first 5000 mm (16 ft.) of pipe closest to the roof drain including the vertical riser - 25 mm (1 in.) thick.

.2 Drainage piping from refrigerated drinking fountains to nearest 75 mm (3 in.) dia. or larger drain pipe – 25 mm (1 in.) thick.

.3 Drainage piping carrying chilled condensate to closest funnel floor drain– 25 mm (1 in.) thick

.4 Condensate drainage piping from drain pans / plenums/ penthouse…etc to funnel floor drain – 25 mm (1 inch) thick.

.3 Chilled Water Piping system throughout: Insulate the following pipe with fibreglass insulation of the thickness noted below:

.1 Chilled water piping, supply and return, to and including 100 mm (4 in.) diameter – 25 mm (1 in.) thick.

.2 Chilled water piping, supply and return, larger than 100 mm (4 in.) diameter – 40 mm (1.5 in.) thick.

.3 Chilled glycol solution piping, supply and return, up to and including 100 mm (4 in.) dia. – 25 mm (1 in.) thick.

.4 Chilled glycol solution piping, supply and return, larger and 100 mm (4 in.) dia. – 40 mm (1.5 in.) thick.

.4 Heating Water Piping: Insulate the following pipe with fibreglass insulation of the thickness noted below:

.1 Hot water heating piping, supply and return, up to and including 32 mm (1.25 in.) dia. – 40 mm (1.5 in.) thick.

.2 Hot water heating piping, supply and return, 40 mm (1.5 in.) dia. and larger - 50 mm (2 in.) thick.

.3 Glycol solution heating or heat reclaim piping, supply and return, up to and including 32 mm (1.25 in.) dia. - 40 mm (1.5 in.) thick.

.4 Glycol solution heating or heat reclaim piping, supply and return, 40 mm (1.5 in.) dia. and larger - 50 mm (2 in.) thick.

.5 Boiler feedwater piping – 25 mm (1 in.) thick.

.6 Boiler blowdown piping – 25 mm (1 in.) thick.

.5 Special Piping: Insulate the following pipe with fibreglass insulation of the thickness noted below:

.1 All piping located outside building or inside building in unheated areas and indicated to be traced with electric heating cable – 50 mm (2 in) thick.

.2 Power washer piping – 25 mm (1 in.) thick.

.3 Air compressor set fresh air intake piping – 25 mm (1 in.) thick.

.6 Piping: Ensure that the overlap flap of the sectional insulation jacket is secured tightly in place. Cover section to section butt joints with tape sealant.

.7 Fittings: Insulate fittings with sectional pipe insulation mitred to fit tightly, and cover butt joints with tape sealant, or, alternatively, wrap fittings with blanket fibreglass insulation to a thickness and insulating value equal to the sectional insulation and secured in place with adhesive and/or wire and covered with PVC fitting covers. Provide sufficient material to prevent the PVC cover from being pushed in or crushed.

.8 "Cold" Piping Valves, Strainers, Etc.: Insulate valves, strainers, and similar piping system accessories in "cold" piping such as potable water piping with cut and tightly fitted segments of sectional pipe insulation with all joints covered with tape sealant, or, alternatively, wrap the piping valve, strainer, etc., with blanket fibreglass and cover with PVC covers as for "Fittings" above.

.9 Flanges and Mechanical Couplings: Terminate sectional insulation approximately 50 mm from the flange or coupling on each side of the flange or coupling. Cover the flange or coupling with a minimum 50 mm (2 in.) thickness of blanket fibreglass insulation wide enough to butt tightly to the ends of the adjacent sectional insulation. Secure the blanket insulation in place and cover with a PVC cover. Provide sufficient material to prevent the PVC cover from being pushed in or crushed.

.10 Concealed Rough-In piping at Plumbing Fixtures: Take special care at concealed potable water rough-in piping at plumbing fixtures to ensure that the piping is properly insulated. If necessary due to space limitations, use 12 mm (0.5 in.) thick sectional pipe insulation in lieu of 25 mm (1 in.) thick insulation.

.11 Alternative Phenolic Foam Insulation: Phenolic foam insulation with a thickness to give an equivalent insulating value to that of the fibreglass insulation and secured in place and sealed in accordance with the manufacturer’s recommendations is acceptable in lieu of fibreglass insulation.

3.3 PIPE INSULATION REQUIREMENTS - CALCIUM SILICATE “SUPER CALTEMP GOLD 1700”:

.1 Insulate the following pipe with calcium silicate insulation of the thickness noted:

.1 Emergency power engine-generator and co-generator set exhaust system piping inclusive of all exhaust devices, indoor and outdoor, throughout – 100 mm (4 inch) thick (or 2 layers each of 50 mm (2 inch) thick).

.2 Piping: Tightly butt together adjoining sections of insulation and secure in place with stainless steel bands or annealed wire on 300 mm (12 inch) centres. Carefully and accurately cut-out insulation at weld beads.

.3 Fittings, Valve, etc.: Insulate elbows, valves and all fittings with mitred segments of the sectional insulation secured in place with wire and fill all gaps with insulating cement, or insulate elbows, valves and similar fittings with insulating cement applied to conform to the shape of the elbow, valve, or similar fitting, and to a thickness and insulating value equal to that of the sectional insulation, and then wrap with glass fibre cloth tape set in lagging adhesive.

.4 Alternatively insulate indoor emergency power engine-generator and co-generator set exhaust system piping inclusive of all exhaust devices with 125 mm (5 inch) thick; or 2 layers, one of 50 mm (2 inch) thick, one of 75 mm (3 inch) thick of High-Temp Blanket Fibreglass.

3.4 PIPE INSULATION REQUIREMENTS – FLEXIBLE ELASTOMERIC FOAM

.1 As an alternative for chilled water piping equipment provide flexible elastomeric foam with a thickness to give an equivalent insulating value to that of the fibreglass insulation, secured in place and sealed in accordance with the manufacturer's recommendations.

.2 Install flexible elastomeric pipe insulation in strict accordance with the manufacturer's published instructions to suit the application, and using adhesive, joint sealants and finish to produce a water-tight installation. Provide Armaflex "Armafix" insulation pipe hangers (IPH) or ZSi-Foster "Cush-A-Therm" clamps at all support locations.

.3 Refrigeration Piping shall be insulated as follows:

.1 Refrigerant piping inside and outside the building – 25 (1 inch) thick.

.2 Refrigerant suction piping (between compressor and evaporator coil) inside building – 25 mm (1 inch) thick.

.3 Refrigerant hot gas piping (between compressor and condenser) inside building – 25 mm (1 inch) thick.

3.5 PIPE INSULATION REQUIREMENTS – CLOSED CELL FOAMED GLASS:

.1 Install closed cell foamed glass insulation in strict accordance with the manufacturer's published instructions to suit the application, and using adhesive, joint sealants, and jacketing to produce a 100 percent water-tight installation. Insulate the following pipe with closed cell foamed glass of the thickness noted:

.1 Electrically heat traced piping outdoors.

.2 Exterior piping required to be insulated.

.3 Indoor potential high humidity areas or corrosive areas, such as bus wash areas, bus undercarriage wash area, bus wrap areas, power wash areas, steam bay areas.

3.6 PIPE INSULATION REQUIREMENTS – FIRE RATED INSULATION

.1 Where pipe which is to be insulated as specified above penetrates fire rated walls and slabs, provide fire-rated, non-combustible sectional insulation on the portion of pipe in the fire barrier and for a distance of 50 mm (2 in.) on either side of the fire barrier.

.2 Insulation thickness shall be as specified, but in any case, a minimum thickness of 25 mm (1 in.).

.3 Install insulation in strict adherence with the manufacturer's printed installation instructions unless noted otherwise.

3.7 INSTALLATION OF WHEELCHAIR LAVATORY INSULATION KITS

.1 Provide manufactured insulation kits to cover exposed drainage and water piping under new wheelchair lavatories.

3.8 EQUIPMENT INSULATION REQUIREMENTS – BLANKET TYPE FIBREGLASS

.1 Insulate the following equipment with fibreglass blanket type insulation of the thickness noted below:

.1 Chilled water and/or potable cold water pump casings – 40 mm (1.5 in.) thick

.2 Roof drain sumps where inside the building - 25 mm (1 in.) thick

.3 Water meter(s) - 40 mm (1.5 in.) thick

.2 Wrap the equipment to a thickness and insulating value equal to an equivalent thickness of rigid sectional pipe insulation. Laminate the insulation in place with adhesive and secure with wire. Apply a jacket of the insulation vapour barrier material secured in place with adhesive or sealant tape.

.3 Cover roof drain sumps with purpose made PVC fitting covers.

3.9 EQUIPMENT INSULATION REQUIREMENTS – SEMI-RIGID FIBREGLASS

.1 Insulate the following equipment with semi-rigid fibreglass board insulation of the thickness noted below:

.1 Heat exchangers – 40 mm (1.5 in.) thick

.2 Heating main air separator – 40 mm (1.5 in.) thick

.2 Install the insulation as required to fit the shape and contour of the equipment. Secure the insulation in place with adhesive, and with aluminum straps on 450 mm centres. Cover the insulation with mesh secured to the metal bands. Lace edges of the wire mesh together. Apply a 6 mm (0.25 in.) thick skim coat of insulating cement, then, when the insulating cement has dried, apply a 6 mm (0.25 in.) thick coat of cement trowelled smooth.

.3 For “cold” equipment such as the chilled water heat exchangers, prime the insulation with suitable sealer and apply a jacket of glass thread reinforced foil and kraft paper vapour barrier jacket material laminated in place with a full coverage of adhesive.

.4 Provide removable and replaceable insulated metal covers for all equipment with removable heads to permit the heads to be removed and replaced without damaging the adjacent insulation work.

3.10 EQUIPMENT INSULATION REQUIREMENTS – FLEXIBLE FOAM ELASTOMERIC

.1 As an alternative for “cold” equipment such as the chilled water heat exchangers, pump casings, etc., flexible elastomeric insulation with a thickness to give an equivalent insulating value to that of the fibreglass insulation, secured in place and sealed in accordance with the manufacturer’s recommendations.

.2 Install flexible elastomeric insulation in strict accordance with the manufacturer’s printed insulation instructions, and insulate all components shown or noted in the instructions. Insulate auxiliary water piping as per chilled water piping. Provide removable sections of insulation at all components that require servicing, and secure with stainless steel straps.

3.11 EQUIPMENT INSULATION REQUIREMENTS – CALCIUM SILICATE “SUPER CALTEMP GOLD 1700”:

.1 Insulate the following equipment with calcium silicate equipment insulation of the thickness noted:

.1 Emergency power engine-generator and co-generator set exhaust system piping, muffler(s), catalytic convertors, inclusive of all exhaust devices, indoor and outdoor, throughout – 100 mm (4 inch) thick (or 2 layers each of 50 mm (2 inch) thick).

.2 Two pieces or V blocks calcium silicate to fit the shape and contour of the equipment and secure the insulation in place with 12 mm (1/2-inch) stainless steel banding at approximately 300 mm to 400 mm (12 to 16 inches) on center. Cover any open gaps with high temperature cement. Cover insulation with 0.61mm (0.016 inch) thick Type 304 stainless steel jacket secure with 13 mm (½") stainless steel banding at approximately 300 mm to 400 mm (12 to 16 inches) on center.

.3 Alternatively insulate indoor emergency power engine-generator and co-generator set exhaust system piping inclusive of all exhaust devices with 125 mm (5 inch) thick; or 2 layers, one of 50 mm (2 inch) thick, one of 75 mm (3 inch) thick of High-Temp Blanket Fibreglass.

3.12 DUCTWORK INSULATION REQUIREMENTS – FIBREGLASS

.1 Insulate the following ductwork systems with fibreglass insulation of the thickness noted below:

.1 All fresh air intake ductwork, casings and plenums from fresh air intakes to and including mixing plenums or sections, or, if mixing plenums or sections are not provided, to the first heating coil, or if both mixing plenums or sections and heating coil sections are not provided, and the fresh air is not tempered, then the fresh air ductwork system complete – 50 mm (2 in.) thick

.2 Mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated – 50 mm (2 in.) thick rigid board or 40 mm (1.5 in.) thick flexible blanket

.3 Supply air ductwork outward from fans, except for supply ductwork exposed in the area it serves:

.1 50 mm (2 in.) thick rigid board or 40 mm (1.5 in.) thick flexible blanket

.2 Supply air ductwork passing through open web steel joists or in other areas where it's not practicable to install 50 mm (2 in.) thick rigid board or 40 mm (1.5 in.) thick flexible blanket, it is acceptable to reduce the insulation thickness to 25 mm (1 in.) thick rigid board or 25 mm (1 in.) thick flexible blanket for a maximum length of 10m (33ft).

.4 Exhaust discharge ductwork for a distance of 3 m (10 ft.) downstream (back) from exhaust openings to atmosphere, including any exhaust plenums within the 3 m (10 ft.) distance or up until the motor operated damper – 50 mm (2 in.) thick rigid board or 40 mm (1.5 in.) thick flexible blanket

.5 Any other ductwork, casings, plenums or sections specified or detailed on the Drawings to be insulated – thickness shall be as specified on the Drawings.

.2 Insulation for casings, plenums, exposed rectangular ductwork shall be rigid board type. Insulation for round ductwork and concealed rectangular ductwork shall be blanket type.

.3 Liberally apply adhesive to all surfaces of the ductwork and/or casing. Provide weld-on pins at 450 mm (18 in.) centres on the bottom duct surface only where blanket insulation is to be applied, and at 450 mm (18 in.) centres on bottom and side surfaces of ducts and/or casings where board insulation is to be applied. Secure the insulation in place with tight circumferential and longitudinal joints. Secure and seal all joints with 75 mm (3 in.) wide tape sealant. Install self-locking washers over pins and cut-off any excess pin length. Ensure that the insulation does not sag or bulge.

.4 Provide drywall type metal corner beads on edges of exposed rectangular ductwork, casings and plenums in equipment rooms, service corridors, and any other area where the insulation is subject to accidental damage. Secure in place with tape sealant.

.5 At each trapeze type duct hanger under rectangular or oval ductwork to be insulated with blanket type insulation, provide a 100 mm (4 in.) wide full length piece of rigid fibreglass board insulation between the duct and the hanger and cover joints with strips of tape sealant.

.6 At each band type duct hanger around round ductwork to be insulated, provided a 100 mm (4 in.) wide section of sleeve or scored board type fibreglass insulation and cover joints with tape sealant.

3.13 DUCTWORK INSULATION REQUIREMENTS - FLEXIBLE ELASTOMERIC:

.1 Insulate all exposed exterior ductwork (except fresh air intake ductwork), and some indoor ductwork, and associated plenums and/or casings outside the building with 65 mm (2-1/2 inch) thick flexible elastomeric sheet insulation applied in two layers, one 25 mm (1-inch) thick layer, and one 40 mm (1-1/2) thick layer, with staggered tightly butted joints.

.1 Similarly, insulate the indoor ductwork located in potential high humidity areas, water spray areas, or corrosive areas, such as bus wash areas, undercarriage bus wash area, bus wrap areas, power wash areas (multiple locations), steam bay areas with same two layers of insulation with the total thickness matching the indoor ductwork requirements.

.2 Install the insulation in strict accordance with the manufacturer's published instructions to produce a weather-proof installation. Seal sheet metal work joints watertight with duct sealer prior to applying insulation.

3.14 DUCT WRAP REQUIREMENTS – FIRE RATED MATERIAL

.1 Provide blanket type fire rated duct wrap system material at the locations where indicated on the Contract Drawings, the duct wrap shall produce the fire rating of the fire barrier that the duct is penetrating.

.2 Install the duct wrap material in accordance with CAN/ULC S144 design requirements and the wrap supplier’s recommendations.

.3 Coordinate installation of duct wrap with the installation of the ductwork specified in Section 23 30 00 – HVAC Ducts and Plenums.

.4 Arrange and pay for the duct wrap supplier to examine the completed duct wrap system at the site. Submit a letter from the supplier to the Contract Administrator to certify that the duct wrap system has been properly installed.

3.15 INSTALLATION OF ACOUSTIC LAGGING

.1 Provide acoustic lagging wherever shown and/or specified on the Contract Drawings.

.2 Wrap duct or unit casing with fibreglass decoupling layer and mass loaded barrier. Fasten joints with foil scrim kraft (FSK) facing tape.

.3 Install materials per applicable local regulations, and fire ratings.

3.16 INSULATION FINISH REQUIREMENTS

.1 White Sheet PVC: Typically, exposed piping and/or ductwork insulation inside the building will not require a finishing jacket. However, if explicitly requested on the Contract Drawings, jacket exposed insulation work inside the building with white sheet PVC and fitting covers tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Seal all joints to produce a neat water-tight installation. Provide slip-type expansion joints where required by the manufacturer's instructions.

.2 Aluminum: Install aluminum jacket material tightly in place with overlapped circumferential joints positioned to shed water and covered with butt straps supplied with the jacket.

.1 Exterior Piping.

.2 Exterior Refrigerant Piping (Alternatively, Factory Applied Jacket - Flexible Elastomeric Foam Insulation may be used.).

.3 Exterior Ductwork (inclusive of ductwork in canopies)

.4 Interior piping and ductwork, located in potential high humidity areas, water spray areas, or corrosive areas, such as bus wash areas, undercarriage bus wash area, bus wrap areas, power wash areas (multiple locations), steam bay areas.

.3 Stainless Steel: Install stainless steel jacket material tightly in place with overlapped circumferential joints positioned to shed water and covered with butt straps supplied with the jacket. Provide stainless steel jacket and fittings for the following:

.1 Generator and co-generator exhaust system indoors and outdoors, throughout.

.4 Protective Coating - Foamed Glass Insulation: Apply two coats of "PITTCOTE 404" coating to all foamed glass insulation exposed above grade as manufacturer recommendations.

.5 Protective Coating – Flexible Elastomeric Insulation: Apply two coats of the coating specified in the Contract Documents to all flexible elastomeric insulation exposed above grade as manufacturer recommendations.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 20 05 93 – Testing, Adjusting, and Balancing (TAB).

.3 Section 22 08 00 – Commissioning of Plumbing.

.4 Section 22 11 23 – Domestic Water Pumps.

.5 Section 23 08 00 – Commissioning of HVAC.

.6 Section 23 21 23 – Hydronic Pumps.

.7 Section 23 34 00 – HVAC Fans

.8 Section 23 72 00 – Hydronic Air Handling Units.

.9 Section 23 74 00 - DX & Gas-fired Air Handling Units.

.10 Section 25 50 00 – Building Automation System (BAS).

.11 Section 25 95 00 – Sequence of Operation

1.2 REFERENCE STANDARDS

.1 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE 519-1992, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

.2 National Electrical Manufacturer Association (NEAM)

.1 NEMA Standard 250, Electrical Enclosure Types – Non Hazardous Location Environmental Rating Standards.

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit complete material, construction and performance shop drawings for variable frequency drives. Include the following:

.1 Drive performance data.

.2 Materials of construction.

.3 Size and weight of drive.

.4 BAS sequencing and control information.

.5 Electrical connection sizes and approximate locations.

.6 Operating and Maintenance Data.

.7 Start-up and Commissioning Data: Submit start-up and commissioning data in accordance with requirements specified in Section 20 05 93 - Testing, Adjusting, and Balancing (TAB).

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 VARIABLE FREQUENCY DRIVES (VFDS)

.1 Variable Frequency Drives: provide variable frequency drives for all mechanical systems as shown in the Schedules and drawings.

.2 HVAC / drive control wiring interface to be provided by Division 25, Building Automation Systems. Each VFD shall be provided with BACnet compatible control interface. Provide points list and integration information to Division 25, Building Automation Systems as required.

.3 Provide approved VFDs with horsepower ratings to match the fan motors as indicated on the drawing schedules and complete with features and characteristics as follows:

.1 All VFDs of 25 HP and lower shall be supplied complete with Hammond RM Series or MTE three phase input line reactors or approved equivalent, required to provide line transient voltage protection. A minimum of 5% is required.

.2 All VFD's of 30 hp and above shall be equipped with MIRUS International Inc. LINEATOR™ Universal Harmonic Filter (UHF), MTE Matrix Filter or approved equivalent to reduce total harmonic current and voltage distortion to the limits specified by Standard IEEE 519 1992 at the input terminals of the harmonic filters. Input line reactors are not acceptable. A single Lineator is acceptable for use with both the supply and return fans.

.3 The VFD shall be of the fully digital pulse width modulated (PWM) type utilizing insulated gate bipolar transistors (IGBT's) in the inverter section of the VFD. The VFD shall accept AC line voltage variation of +15%. No transformers shall be used on either the input or output of the VFD.

.4 Displacement Power Factor: 0.98 over entire range of operating speed and load.

.5 Minimum efficiency: 96%.

.6 Overload capacity: 120% for Variable Torque Application & 150% for 1 min. for Constant Torque Applications.

.7 All drive parameters (set up, operating and adjustment settings) to be entered via keypad, without tools. Three adjustable set-points to lock out continuous operation at frequencies which may produce mechanical resonance. Drive to be capable of determining the speed and direction of a spinning motor and adjusting its output to "pick-up" the motor at the rotating speed. The flying start feature is to be operable with, or without, encoder feedback.

.8 For indoor applications inside mechanical rooms, provide surface mounting NEMA 12 ventilated enclosure with hinged door and filter suitable for rack mounting, designed to provide electromagnetic shielding. Provide a Hand-Off-Auto switch on face of panel for control of VFD's as per control drawings.

.9 NEMA 12 ventilated enclosure or Open (Protected) Chassis VFD with keypad/display installed through the door of the VFD panel enclosure (accessible on outside face of door).

.10 For outdoor applications or units located in potential high humidity areas, water spray areas, or corrosive areas, such as bus wash areas, undercarriage bus wash area, bus wrap areas, power wash areas (multiple locations), steam bay areas, provide NEMA 4x enclosures.

.11 Provide incoming, horsepower rated, disconnect switch with an operating mechanism.

.12 Provide input line fuses coordinated with the VFD's electronic protection circuits so as not to blow under normal output faults such as overcurrent, short circuit and ground fault.

.13 Provide output line reactors if the distance between the VFD and motor is greater than 10m and/ or as per manufacturer recommendation.

.14 If the HOA switch is in "Auto" the fan ramps up to its current assigned speed setting over an adjustable time period (up to 90 seconds). If the HOA switch is in "Hand" the fan ramps up to the minimum speed setting and is controlled thereafter from the VFD keypad display.

.4 Protection:

.1 Provide the VFD with internal protection features.

.2 Fault Sensing shall include but not be limited to:

.1 Power On

.2 Overload protection

.3 Overcurrent Protection

.4 Short Circuit Protection

.5 Inverter Fault

.6 External Fault

.7 Over Voltage

.8 Under Voltage and Phase Loss

.9 DC Bus Under-voltage/Over-voltage Protection

.10 Over Temperature Protection

.11 Power Semi-Conductor Protection

.12 Ground Fault Protection

.13 Heatsink Over-Temperature Protection

.14 Output phase to phase & phase to ground short circuit protection

.5 Environment:

.1 The VFD shall have the following minimum environmental tolerances:

.1 Ambient temperature range of 0°C to 40°C (32ºF to 104ºF).

.2 Units located in non-heated areas or outdoors shall be provided with thermostatically controlled heated weather enclosure.

.3 Maximum humidity of 95% non-condensing.

.4 Maximum altitude of 1000m for rated output.

.6 Performance:

.1 The VFD shall automatically restart after an inverter fault trip. The VFD shall attempt to restart automatically 5 times with Lock Out after the third attempt if a restart has not occurred.

.2 The VFD shall have automatic/manual signal follower for 4 20 mA or 0-10 VDC reference.

.3 All drive parameters (set up, operating and adjustment settings) to be entered via keypad without tools.

.4 "Ride through" of short power interruptions.

.5 Auto restart following fault, except for ground and short circuit faults. The drive shall shut down and annunciate any fault conditions (as a minimum) and display the appropriate fault code on the display of the keypad.

.6 Automatic/manual selection via (Hand/Off/Auto) switch. In manual or hand control, drive speed shall be controlled via the keypad. In automatic control drive speed shall be controlled via 4-20mA and/or a 0-10V DC signal from the BAS (BAS connections by others).

.7 In the event of loss of 4 - 20mA reference signal the drive should give an alarm and maintain last reference (within 10%).

.8 Inverter duty motors with insulated bearings, winding thermistors and suitable for operation from variable frequency drives.

.9 Refer to Plumbing, Fire Protection, HVAC, Building Automation Controls, Industrial and Process systems Divisions for wiring/circuits required to achieve functionality described in the control drawings, electrical drawings (where applicable), process and industrial systems and specifications.

.10 In the Auto mode, the VFD shall modulate motor speeds as instructed by the BAS or other controls device (pushbutton, gas detector, package unit or device…etc).

.11 Output signals to be monitored by BAS or other controls device via BACnet integration module.

.12 Provide thermistor operated relays.

.13 Provide hardwire and communication interface and interlocks.

.7 VFD cabinets are to be complete with door interlocked fused disconnect switch.

.8 VFD supplier is to provide start up assistance and training to the TAB agency and Commissioning Agent and City's staff.

.9 Acceptable Manufactures:

.1 ABB

.2 Danfoss

.3 Yaskawa

.4 Toshiba

.5 Cutler Hammer

3 Execution

3.1 INSTALLATION OF VARIABLE FREQUENCE DRIVES (VFDS)

.1 Comply with manufacturer's installation instructions.

.2 Coordinate VFD location with Electrical Division, provide additional disconnect switches if required by the authorities having jurisdiction. Disconnect switch shall be wired in series to avoid drive operation while the disconnection switch is open.

.3 Locate and mount VFDs as shown on the Drawings.

.4 Arrange for a manufacturer's technical representative:

.1 Inspect the installation of drives prior to start-up.

.2 Test and commission all drives.

.5 Measure the distortion of each phase at the load terminals of the branch breaker and report the results in the commissioning report.

.6 All VFDs shall be installed in a location or panels/ cabinets that meets the environmental conditions.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

1.2 REFERENCE STANDARDS

.1 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S104, Standard Method for Fire Tests of Door Assemblies.

.2 National Building Code 2015 (NBC)

1.3 DEFINITIONS

.1 For purposes of this Section:

.1 "CONCEALED" means mechanical services and equipment in suspended ceilings, non-accessible chases, and furred-in spaces.

.2 "EXPOSED" means "not concealed" as defined in this Section.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings:

.1 Submit a set of shop drawings identifying size, type and location of all access doors, for review, before installation.

.2 Include manufacturer product literature and ULC certification.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 ACCESS DOORS

.1 Masonry Wall Access Doors:

.1 Doors in masonry walls shall be complete with a 16 ga. prime painted steel door panel, rust resistant concealed hinges, flanged frame, and screwdriver operated lock.

.2 Acceptable Manufacturers:

.1 Acudor; Model UF 5000.

.2 Mifab; Model UA.

.3 William Brothers; Model WB-UAD.

.2 Gypsum Board Partition or Ceiling Access Doors:

.1 Doors in drywall partitions or ceilings shall be complete with a 16 ga. prime painted steel recessed door panel for the acceptance of a drywall insert, concealed hinges, drywall bead frame, and screwdriver operated lock.

.2 Acceptable Manufacturers:

.1 Acudor; Model DW 5015.

.2 Mifab; Model CAD-DW.

.3 William Brothers; Model WB-RDW.

.3 Fire Rated Wall or Ceiling Access Doors:

.1 Access doors in fire rated walls or ceilings shall be ULC labeled and certified in accordance with UL 10(b) and CAN/ULC S104 for a minimum 1-1/2 hour rating (rating to increase as necessary to maintain the fire separation integrity). Doors shall be complete with insulated door panel, concealed hinge, self-closing, self-latching, flanged frame, and prime painted. Provide master key operated catch in areas accessible to the public.

.2 Acceptable Manufacturers:

.1 Acudor; Model FW 5050.

.2 Mifab; Model MPFR.

.3 William Brothers; Model WB-FR-S.

.4 Tiled Wall or Ceiling Access Doors:

.1 Doors in tiled walls or ceilings shall be complete with a 16 ga. stainless steel door panel, type 304 with #4 satin finish, concealed hinges, wall frame and screwdriver operated lock.

.2 Acceptable Manufacturers:

.1 Acudor; Model UF 5000.

.2 Mifab; Model UA-SS.

.3 William Brothers; Model WB-UAD-SS.

.5 Minimum size of doors shall be:

.1 300 mm x 300 mm (12 in. x 12 in.) for hand access, wherever practicable. The access door shall be upsized as required to facilitate (and not impede) full accessibility; the access door size shall also accommodate for removal of the device.

.2 200 mm x 200 mm (8 in. x 8 in.) for valves and cleanouts. This door size is only permitted when installation of a 300 mm x 300 mm (12 in. x 12 in.) is not practicable. The access door shall be upsized as required to facilitate (and not impede) full accessibility; the access door size shall also accommodate for removal of the device.

.3 600 mm x 600 mm (24 in. x 24 in.) minimum for body access.

.4 900 mm x 900 mm (36 in. x 36 in.) for access to penal fixture chases.

3 Execution

3.1 INSTALLATION OF ACCESS DOORS

.1 All parts of the installation requiring periodic maintenance shall be accessible. Wherever valves, dampers, motors, instruments, equipment, controllers, control panels and other appurtenances are concealed by building construction, access doors shall be furnished by this Section and installed under the respective Trade Sections (i.e. masonry, drywall, tile, etc.) This Section is responsible for the proper location of the access doors.

.2 Wherever possible, items requiring access shall be located in easily accessible areas (i.e. exposed or removable T-bar ceilings).

.3 Group items in order to minimize the number of access doors required.

.4 Each access door shall be installed to provide complete access to equipment for maintenance and servicing.

.5 The final installed locations of all access doors shall be shown on the As-Built and Record Drawings.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:

.1 Two-piece ball valves with indicators.

.2 Bronze butterfly valves with indicators.

.3 Iron butterfly valves with indicators.

.4 Check valves.

.5 Bronze OS&Y gate valves.

.6 Iron OS&Y gate valves.

.7 NRS gate valves.

.8 Indicator posts.

.9 Trim and drain valves.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements

.2 Section 20 05 48-Vibration Isolation

.3 Section 20 05 50 – Seismic Restraint System.

.4 Section 20 07 00 -Mechanical Insulation

.5 Section 21 13 13 - Wet-Pipe Sprinkler Systems.

.6 Section 21 13 16 - Dry-Pipe Sprinkler Systems.

.7 Section 21 30 00 – Fire Pump

1.3 REFERENCE STANDARDS

.1 ASME

.1 ASME B1.20.1 Pipe Threads, General Purpose, Inch

.2 ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings

.3 ASME B31.9 Building Services Piping

.2 AWWA

.1 AWWA C606 Standard for Grooved and Shouldered

.3 NFPA

.1 NFPA 13 Standard for the Installation of Sprinkler Systems

.2 NFPA 14 Standard for the Installation of Standpipe and Hose

.3 NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection

.4 NFPA 24 Standard for the Installation of Private Fire Service Mains and their Appurtenances.

.4 ULC listed and/ or FM approved

.5 National Building Code

.6 National Fire Code

1.4 DEFINITIONS

.1 NRS: Nonrising stem.

.2 OS&Y: Outside screw and yoke.

.3 SBR: Styrene-butadiene rubber.

1.5 ACTION SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Product Data: For each type of valve.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Prepare valves for shipping as follows:

.1 Protect internal parts against rust and corrosion.

.2 Protect threads, flange faces, and weld ends.

.3 Set valves open to minimize exposure of functional surfaces.

.2 Use the following precautions during storage:

.1 Maintain valve end protection.

.2 Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

.3 Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

.4 Protect flanges and specialties from moisture and dirt.

2 Products

2.1 SOURCE LIMITATIONS

.1 Obtain each type of valve from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

.1 ULC listed and/ or FM approved

.1 Fire Main Equipment: HAMV - Main Level

.2 Indicator Posts, Gate Valve: HCBZ - Level 1

.3 Ball Valves, System Control: HLUG - Level 3

.4 Butterfly Valves: HLXS - Level 3

.5 Check Valves: HMER - Level 3

.6 Gate Valves: HMRZ - Level 3

.7 Sprinkler System & Water Spray System Devices: VDGT - Main Level

.8 Valves, Trim and Drain: VQGU - Level 1

.2 ULC listed and/ or FM approved

.1 Automated Sprinkler Systems:

.1 Indicator posts.

.2 Valves.

.1 Gate valves.

.2 Check valves

.3 Miscellaneous valves.

.3 ASME Compliance:

.1 ASME B1.20.1 for threads for threaded-end valves.

.2 ASME B16.1 for flanges on iron valves.

.3 ASME B31.9 for building services piping valves.

.4 AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

.5 NFPA Compliance for valves:

.1 Comply with NFPA 13, NFPA 14, NFPA 20, and NFPA 24.

.6 Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.

.7 Valve Sizes: Same as upstream piping unless otherwise indicated.

.8 Valve Actuator Types:

.1 Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.

.2 Handwheel: For other than quarter-turn trim and drain valves.

.3 Handlever: For quarter-turn trim and drain valves DN 50 (NPS 2) and smaller.

2.3 TWO-PIECE BALL VALVES WITH INDICATORS

.1 Description:

.1 ULC listed and/ or FM approved

.2 Minimum Pressure Rating: 1200 kPa (175 psig).

.3 Body Design: Two piece.

.4 Body Material: Forged brass or bronze.

.5 Port Size: Full or standard.

.6 Seats: PTFE.

.7 Stem: Bronze or stainless steel.

.8 Ball: Chrome-plated brass.

.9 Actuator: Worm gear

.10 Supervisory Switch: Internal or external.

.11 End Connections for Valves Dn 25 (NPS 1) through DN50 (NPS 2): Threaded ends.

.12 End Connections for Valves DN 65 (NPS 2-1/2): Grooved ends.

2.4 BRONZE BUTTERFLY VALVES WITH INDICATORS

.1 Description:

.1 ULC listed and/ or FM approved

.2 Minimum: Pressure rating: 1200 kPa (175 psig).

.3 Body Material: Bronze.

.4 Seat Material: EPDM.

.5 Stem Material: Bronze or stainless steel.

.6 Disc: Stainless steel with EPDM coating.

.7 Actuator: Worm gear.

.8 Supervisory Switch: Internal or external.

.9 Ends Connections for Valves DN 25 (NPS 1) through DN 50 (NPS 2): Threaded ends.

.10 Ends Connections for Valves DN 65 (NPS 2-1/2): Grooved ends.

2.5 IRON BUTTERFLY VALVES WITH INDICATORS

.1 Description:

.1 ULC listed and/ or FM approved

.2 Minimum Pressure Rating: 1200 kPa (175 psig).

.3 Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.

.4 Seat Material: EPDM.

.5 Stem: Stainless steel.

.6 Disc: Ductile iron, nickel plated and EPDM or SBR coated.

.7 Actuator: Worm gear.

.8 Supervisory Switch: Internal or external.

.9 Body Design: Grooved-end connections.

2.6 CHECK VALVES

.1 Description:

.1 ULC listed and/ or FM approved

.2 Minimum Pressure Rating: 1200 kPa (175 psig).

.3 Type: Single swing check.

.4 Body Material: Cast iron, ductile iron, or bronze.

.5 Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.

.6 Clapper Seat: Brass, bronze, or stainless steel.

.7 Hinge Shaft: Bronze or stainless steel.

.8 Hinge Spring: Stainless steel.

.9 End Connections: Flanged, grooved, or threaded.

2.7 BRONZE OS&Y GATE VALVES

.1 Description:

.1 ULC listed and/ or FM approved

.2 Minimum Pressure Rating: 1200 kPa (175 psig).

.3 Body and Bonnet Material: Bronze or brass.

.4 Wedge: One-piece bronze or brass.

.5 Wedge Seat: Bronze.

.6 Stem: Bronze or brass.

.7 Packing: Non-asbestos PTFE.

.8 Supervisory Switch: External.

.9 End Connections: Threaded.

2.8 IRON OS&Y GATE VALVES

.1 Description:

.1 ULC listed and/ or FM approved

.2 Minimum Pressure Rating: 1200 kPa (175 psig).

.3 Body and Bonnet Material: Cast or ductile iron.

.4 Wedge: Cast or ductile iron, or bronze with elastomeric coating.

.5 Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.

.6 Stem: Brass or bronze.

.7 Packing: Non-asbestos PTFE.

.8 Supervisory Switch: External.

.9 End Connections: Threaded.

2.9 NRS GATE VALVES

.1 Description:

.1 ULC listed and/ or FM approved

.2 Minimum Pressure Rating: 1200 kPa (175 psig).

.3 Body and Bonnet Material: Cast or ductile iron.

.4 Wedge: Cast or ductile iron with elastomeric coating.

.5 Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.

.6 Stem: Brass or bronze.

.7 Packing: Non-asbestos PTFE.

.8 Supervisory Switch: External.

.9 End Connections: Flanged.

2.10 INDICATOR POSTS

.1 Description:

.1 ULC listed and/ or FM approved

.2 Type: Underground.

.3 Base Barrel Material: Cast or ductile iron.

.4 Extension Barrel: Cast or ductile iron.

.5 Cap: Cast or ductile iron.

.6 Operation: Wrench

2.11 TRIM AND DRAIN VALVES

.1 Ball Valves:

.1 Description:

.1 Pressure Rating: 1200 kPa (175 psig).

.2 Body Design: Two piece.

.3 Body Material: Forged brass or bronze.

.4 Port size: Full or standard.

.5 Seats: PTFE.

.6 Stem: Bronze or stainless steel.

.7 Ball: Chrome-plated brass.

.8 Actuator: Handlever.

.9 End Connections for Valves DN 25 (NPS 1) through DN 65 (NPS 2-1/2): Threaded ends.

.10 End Connections for Valves DN 32 and DN 65 (NPS 1-1/4 and NPS 2-1/2): Grooved ends.

.2 Angle Valves:

.1 Description:

.1 Pressure Rating: 1200 kPa (175 psig).

.2 Body Material: Brass or bronze.

.3 Ends: Threaded.

.4 Stem: Bronze.

.5 Disc: Bronze.

.6 Packing: Asbestos free.

.7 Handwheel: Malleable iron, bronze, or aluminum.

.3 Globe Valves:

.1 Description:

.1 Pressure Rating: 1200 kPa (175 psig)

.2 Body Material: Bronze with integral seat and screw-in bonnet.

.3 Ends: Threaded.

.4 Stem: Bronze.

.5 Disc Holder and Nut: Bronze.

.6 Disc Seat: Nitrile.

.7 Packing: Asbestos free.

.8 Handwheel: Malleable iron, bronze, or aluminum.

.4 Gate Valves:

.1 Description:

.1 Pressure Rating: 1200 kPa (175 psig)

.2 Body Material: Brass or bronze.

.3 Ends: Threaded.

.4 Stem: Brass or Bronze.

.5 Disc: Bronze.

.6 Packing: Asbestos free.

.5 Handwheel: Malleable iron, bronze, or aluminum.

3 Execution

3.1 EXAMINATION

.1 Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

.2 Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

.3 Examine threads on valve and mating pipe for form and cleanliness.

.4 Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

.5 Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION, GENERAL

.1 Comply with requirements in the following Sections for specific valve-installation requirements and applications:

.1 Section 211200 "Fire-Suppression Standpipes" for application of valves in fire-suppression standpipes.

.2 Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.

.3 Section 211316 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems.

.2 Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply, except from fire-department connections. Install permanent identification signs, indicating portion of system controlled by each valve.

.3 Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

.4 Install valves in horizontal piping with stem at or above the pipe center.

.5 Install valves in position to allow full stem movement.

.6 Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and or other labeling and painting contractual requirements.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:

.1 Exposed-type fire-department connections.

.2 Flush-type fire-department connections.

.3 Yard-type fire-department connections.

1.2 RELATED REQUIREMENTS

.1 Section 03 30 00 - Cast-in-Place Concrete

.2 Section 05 50 00 - Metal Fabrications

.3 Section 20 05 00 – General Mechanical Requirements

1.3 REFERENCE STANDARDS

.1 Underwriters Laboratory (UL)

1.4 ACTION SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Product Data: For each type of product.

.1 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

2 Products

2.1 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

.1 Standard: UL 405.

.2 Type: Exposed, projecting, for wall mounting.

.3 Pressure Rating: 1200-kPa (175-psig) minimum.

.4 Body Material: Corrosion-resistant metal.

.5 Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

.6 Caps: Brass, lugged type, with gasket and chain.

.7 Escutcheon Plate: Round, brass, wall type.

.8 Outlet: Back, with pipe threads.

.9 Number of Inlets: Two.

.10 Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE"

.11 Finish: Polished chrome plated.

.12 Outlet Size: DN 100 (NPS 4).

2.2 FLUSH-TYPE FIRE-DEPARTMENT CONNECTION

.1 Standard: UL 405.

.2 Type: Flush, for wall mounting.

.3 Pressure Rating: 1200-kPa (175-psig) minimum.

.4 Body Material: Corrosion-resistant metal.

.5 Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

.6 Caps: Brass, lugged type, with gasket and chain.

.7 Escutcheon Plate: Rectangular, brass, wall type.

.8 Outlet: With pipe threads.

.9 Body Style: Horizontal.

.10 Number of Inlets: Three.

.11 Outlet Location: Bottom .

.12 Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."

.13 Finish: Polished chrome plated.

.14 Outlet Size: DN 100 (NPS 4).

2.3 YARD-TYPE-DEPARTMENT CONNECTION

.1 Standard: UL 405.

.2 Type: Exposed, freestanding.

.3 Pressure Rating: 1200-kPa (175 psig) minimum.

.4 Body Material: Corrosion-resistant metal.

.5 Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

.6 Caps: Brass, lugged type, with gasket and chain.

.7 Escutcheon Plate: Round, brass, floor type.

.8 Outlet: Bottom, with pipe threads.

.9 Number of Inlets: Three.

.10 Sleeve: Brass.

.11 Sleeve Height: 460 mm (18 inches).

.12 Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."

.13 Finish, Including Sleeve: Polished chrome plated

.14 Outlet Size: DN 100 (NPS 4).

3 Execution

3.1 EXAMINATION

.1 Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.

.2 Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Install wall-type fire-department connections.

.2 Install yard-type fire-department connections in concrete slab support. Comply with requirements for concrete in Section 03 30 00 - Cast-in-Place Concrete.

.3 Install two protective pipe bollards on sides of each fire-department connection. Comply with requirements for bollards in Section 05 50 00 - Metal Fabrications.

.4 Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:

.1 Pipes, fittings, and specialties.

.2 Fire-protection specialty valves.

.3 Hose connections.

.4 Alarm devices.

.5 Manual control stations.

.6 Control panels.

.7 Pressure gauges.

1.2 RELATED REQUIREMENTS:

.1 Section 20 05 00 – General Mechanical Requirements

.2 Section 20 05 48-Vibration Isolation

.3 Section 20 05 50 – Seismic Restraint System.

.4 Section 20 07 00 -Mechanical Insulation

.5 Section 21 05 23 - General-Duty Valves for Water-Based Fire-Suppression Piping.

.6 Section 21 13 13 - Wet-Pipe Sprinkler Systems.

.7 Section 21 13 16 - Dry-Pipe Sprinkler Systems.

.8 Section 21 30 00 – Fire Pump

1.3 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code

.2 ASME B1.20.1 Pipe Threads, General Purpose, Inch

.3 ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings

.4 ASME B16.4 Cast Iron Threaded Fittings

.5 ASME B16.5 Pipe Flanges and Flanged Fittings

.6 ASME B16.9 Factory-Made Wrought Steel Butt-welding Fittings

.7 ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings

.8 ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

.9 ASME B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings

.10 ASME B18.2.1 Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series),

.11 ASME B31.9 Building Services Piping

.2 ASTM

.1 ASTM A47/A47M Standard Specification for Ferritic Malleable Iron Castings

.2 ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.3 ASTM A135/A135M Standard Specification for Electric-Resistance-Welded Steel Pipe

.4 ASTM A234/A234M Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

.5 ASTM A536 Standard Specification for Ductile Iron Castings

.6 ASTM A795/A795M Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

.7 ASTM A865/A865M Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints

.8 ASTM B75/B75M Standard Specification for Seamless Copper Tube

.9 ASTM B88 Standard Specification for Seamless Copper Water Tube

.10 ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications

.3 AWS

.1 AWS A5.8M/A5.8 Specification For Filler Metals For Brazing And Braze Welding

.2 AWS D10.12M/D10.12 Guide For Welding Mild Steel Pipe-American Welding Society

.4 AWWA

.1 AWWA C606 Standard for Grooved and Shouldered Joints

.2 AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings

.5 FM Global's "Approval Guide"

.6 NFPA

.1 NFPA 13 Standard for the Installation of Sprinkler Systems

.2 NFPA 14 Standard for the Installation of Standpipe and Hose Systems

.3 NFPA 70 National Electrical Code

.4 NFPA 291 Recommended Practice for Fire Flow Testing and Marking of Hydrants

.5 NFPA 1963 Standard for Fire Hose Connections

.7 MSS

.1 MSS SP-123 Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube

.8 ULC listed and/ or FM approved

1.4 DEFINITIONS

.1 High-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure of higher than standard 1200-kPa (175-psig), but not higher than 1725-kPa (250-psig).

.2 Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at maximum working pressure of 1200-kPa (175-psig).

1.5 ACTION SUBMITTALS

.1 Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

.2 Shop Drawings: For fire-suppression standpipes.

.1 Include plans, elevations, sections, and attachment details.

.2 Include diagrams for power, signal, and control wiring.

.3 Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Licensed Professional Engineer responsible for their preparation.

.4 Regulatory requirements:

.1 Prior to purchase and installation of standpipe system, submit documents to authority having jurisdiction and obtain their approval.

.2 Make submissions to authority having jurisdiction well in advance so as not to delay installation.

1.6 INFORMATIONAL SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Coordination Drawings: Floor plans, sections, and other details, drawn to scale, or BIM model, showing the items described in this Section and coordinated with all building trades.

.3 Qualification Data: For Installer and Professional Engineer.

.4 Approved Standpipe Drawings: Working plans, prepared in accordance with NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations,.

.5 Welding certificates.

.6 Fire-hydrant flow test report.

.7 Field Test Reports and Certificates:

.1 Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

.2 Fire-hydrant flow test report.

.8 Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

.1 Installer Qualifications:

.1 Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

.1 Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified Professional Engineer.

.2 Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

2 Products

2.1 SYSTEM DESCRIPTIONS

.1 Automatic Wet-Type, Class I Standpipe System: Includes DN 65 (NPS 2-1/2) hose connections, has open water-supply valve with pressure maintained, and is capable of supplying water demand.

2.2 PERFORMANCE REQUIREMENTS

.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

.2 NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14.

.3 Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 1200-kPA (175-psig) minimum working pressure.

.4 High-Pressure, Fire-Suppression Standpipe System Component: Listed for 1725-kPa (250-psig) minimum working pressure.

.5 Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified Professional Engineer, using performance requirements and design criteria indicated.

.6 Fire-suppression standpipe design shall be approved by authorities having jurisdiction.

.1 Minimum residual pressure at each hose-connection outlet is as follows:

.1 DN 40 (NPS 1-1/2) Hose Connections: 450-kPa (65 psig).

.2 DN 65 (NPS 2-1/2) Hose Connections: 690-kPa (90-psig).

.7 Seismic Performance: See Section 20 05 50 – Seismic Restraint System, as applicable.

.8 Interruption of Existing Fire-Suppression Standpipe Service: Do not interrupt fire-suppression standpipe service to facilities occupied by City or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression standpipe service in accordance with requirements indicated:

.1 Notify Construction Contractor/City no fewer than two days in advance of proposed interruption of fire-suppression standpipe service.

.2 Do not proceed with interruption of fire-suppression standpipe service without Construction Contractor/City's written permission.

2.3 STEEL PIPE AND FITTINGS

.1 PVC: Ipex "Brute Brute " Class 200, DR14, rigid, hub and spigot pattern PVC pipe and CSA certified fittings to CSA B137.2 and B137.3, ULC listed and FM approved and complete with gasketed joints.

.2 Schedule 40 Steel - Grooved Coupling Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with mill or site roll grooved ends, and Victaulic "Fire Lock" or "FIT Style 960 fittings", Gruvlock Fig. #7105 "Sock-It" fittings, Tyco Fire Suppression & Building Products Mechanical Outlet Tee Fig. 730 and Victaulic Style 005, Tyco Fire Suppression & Building Products #772, Gruvlok Rigid-Lite #7400, Shurjoint "Speed"or "Z05" rigid coupling joints or approved equivalent. Snap-Let type or strap type fittings are not acceptable.

.3 Schedule 40 Steel - Screwed and Welded Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B. Screwed piping is to be complete with Class 125 cast iron screwed fittings to ANSI/ASME B16.4. Welded piping is to be complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, long sweep pattern wherever possible.

.4 Schedule 10 Steel - Grooved Coupling Joints: Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with mill or site roll grooved ends, and Victaulic "Fire Lock" fittings, Tyco Fire Suppression & Building Products grooved fittings and Victaulic Style 005, Tyco Fire Suppression & Building Products #772, Gruvlok Rigid-Lite #7400 rigid coupling joints or approved equivalent. Snap-Let type or strap type fittings are not acceptable.

.5 Schedule 10 Steel - Screwed Joints: Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with mill or site threaded ends, Class 125 cast iron screwed fittings to ANSI/ASME B16.4, and screwed joints.

2.4 PIPING JOINING MATERIALS

.1 Pipe-Flange Gasket Materials: AWWA C110/A21.10, rubber, flat face, 3.2-m (1/8 inch) thick.

.1 Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

.2 Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

.2 Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1 carbon steel unless otherwise indicated.

.3 Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 FIRE HOSE CABINET AND VALVE ASSEMBLY

.1 National Fire Equipment Ltd. or approved equivalent, fire hose cabinet assemblies as indicated on drawings and as specified below.

.2 National Fire Equipment Ltd. ULC listed and FM approved fire hose cabinet assemblies, each complete :

.1 Cold rolled steel with a basked enamel finish

.2 18 gauge with universal knockouts for tubs

.3 14 gauge for doors and trim

.4 All metal edge shall be ground and rounded

.5 Doors complete with:

.1 Hollow channel reinforcement

.2 Full length semi-concealed piano hinge with paint stop feature and design to permit 180° door opening

.3 Full removable panel of 6 mm (1/4”) thick clear safety glass with adhesive centre

.4 Flush stainless steel door latch

.6 National Fire Equipment Ltd. Model C-975 or equivalent for hose valve cabinet

.7 National Fire Equipment Ltd. Model C-21 or equivalent for spanner wrench

.8 UL 668, brass, 2068 kPa (300 psi) minimum pressure rating, hose connections for connecting fire hose. Include angle or gate patter design, NPT standard thread female inlet and NST standard male hose outlet, and lugged cap, gasket, and chain.

.1 National Fire Equipment Ltd. Model A56 65 mm (2-1/2”), forged brass, satin finish, Fire Department angle hose valve with caps and chains, each chrome plated and polished for Fire Hose Valve.

.2 Provide National Fire A75C DN 65 (NPS 2-1/2) to DN 40 (NPS 1 1/2) connections with threaded hose reducers adapter.

.9 A Model A-156, 40 mm (1-1/2 inch) forged brass, adjustable, pressure restricting angle hose valve.

.10 A Model A-156, 65 mm (2-1/2 inch) forged brass, adjustable, pressure restricting, Fire Department angle hose connection valve with cap and chain.

.11 A Model A-7-B 40 mm (1-1/2 inch) forged brass combination nozzle adjustable for fog, straight stream and shut-off.

.12 30 m (100 feet) of 40 mm (1-1/2 inch) diameter "Polyfex" hose with Model F-4 forged brass couplings, a Model S-4 stationary hose rack with independently swiveling pins, and a Model S-5 automatic water stop.

.13 A Model C-21"Trinal" spanner wrench.

.14 A Model WBDL-ABC310LV, multipurpose, 3A:10BC ULC rated dry chemical fire extinguisher.

.15 Model WBDL-ABC20, multipurpose, 10A:120BC ULC rated dry chemical fire extinguisher.

.3 Recessed cabinets are to be "Knight" Series 200 mm (8 inch) deep cabinets complete with:

.4 A 1.27 mm thick (18 gge) cold rolled steel tub with universal knockouts and a white enamel finish.

.5 A 1.98 mm thick (14 gge) steel door and adjustable trim assembly with rounded corner, full length semi-concealed piano hinge, prime coat finish, full panel of 6 mm (1/4-inch) thick "Duo-Lite" safety glass, and a flush stainless steel door latch.

.6 Surface mounted cabinets are to be Model CS-800 cabinets, each 200 mm deep and complete with:

.7 A 1.27 mm thick (18 gge) cold rolled steel tube with universal knockouts and a white enamel interior finish and prime coated exterior.

.8 A 1.98 mm thick (14 gge) steel door with full length semi-concealed piano hinge, white enamel inside finish, primer coat exterior finish, full panel of 6 mm (1/4-inch) "Duo-Lite" safety glass, and a flush stainless steel door latch.

.9 Surface mounted cabinets in process and industrial areas or located in humid and corrosive locations to be custom made of 316 Stainless Steel with No. 4 Satin Finish. Size of the cabinet similar to Model CS-800 cabinets, each 200 mm deep and complete with:

.1 Custom made of 316 stainless steel tube with universal knockouts.

.2 Custom made of 316 stainless steel with no. 4 satin finish door with full length semi-concealed piano hinge, full panel of 6 mm (¼") "duo-lite" safety glass, and a flush stainless steel door latch.

.10 All brass items in recessed cabinets are to be polished and chrome plated.

.1 Acceptable Alternatives

.1 National Fire Equipment Limited

.2 Wilson and Cousin

.3 Potter-Roemer Inc.

.4 Or approved equivalent.

2.6 SPECIALTY VALVES

.1 General Requirements:

.1 ULc listed and/ or FM approved

.2 Pressure Rating:

.1 Standard-Pressure Piping Specialty Valves: 1200-kPa (175-psig) minimum.

.2 High-Pressure Piping Specialty Valves: 1725-kPa (250-psig) minimum.

.3 Body Material: Cast or ductile iron.

.4 Size: Same as connected piping.

.5 End Connections: Flanged or grooved.

.2 Alarm Valves:

.1 ULc listed and/ or FM approved

.2 Design: For horizontal or vertical installation.

.3 Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, and fill-line attachment with strainer.

.4 Drip Cup Assembly: Pipe drain with check valve to] main drain piping.

.3 Pressure-Reducing Valves:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 2070-kPa (300-psig) minimum.

.3 Material: Brass or bronze.

.4 Inlet: Female pipe threads.

.5 Outlet: Threaded with or without adapter having male hose threads.

.6 Pattern: Angle.

.7 Finish: Polished chrome plated.

.4 Automatic (Ball Drip) Drain Valves:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 2070-kPa (300-psig) minimum.

.3 Material: Brass or bronze.

.4 Size: DN 40 or DN 65 (NPS 1-1/2 or NPS 2-1/2), as indicated.

.5 Inlet: Female pipe threads.

.6 Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads in accordance with NFPA 1963 and matching local fire-department threads.

.7 Pattern: Angle.

.8 Pressure-Control Device Type: Pressure reducing.

.9 Finish: Polished chrome plated.

2.7 ALARM DEVICES

.1 Match alarm-device material and connection types to piping and equipment materials and connection types.

.2 Water-Motor-Operated Alarm:

.1 ULc listed and/ or FM approved

.2 Type: Mechanically operated, with pelton wheel.

.3 Alarm Gong: Cast aluminum with red-enamel factory finish.

.4 Size: 250-mm (10-inch) diameter.

.5 Components: Shaft length, bearings, and sleeve to suit wall construction.

.6 Inlet: DN 20 (NPS 3/4).

.7 Outlet: DN 25 (NPS 1) drain connection.

.3 Electrically Operated Alarm Bell:

.1 ULc listed and/ or FM approved

.2 Type: Vibrating, metal alarm bell.

.3 Size: 150-mm (6-inch) minimum diameter.

.4 Finish: Red-enamel factory finish, suitable for outdoor use.

.4 Water-Flow Indicators:

.1 ULc listed and/ or FM approved

.2 Water-Flow Detector: Electrically supervised.

.3 Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

.4 Type: Paddle operated.

.5 Pressure Rating: 1725-kPa (250 psig).

.6 Design Installation: Horizontal or vertical.

.5 Pressure Switches:

.1 ULc listed and/ or FM approved

.2 Type: Electrically supervised water-flow switch with retard feature.

.3 Components: Single-pole, double-throw switch with normally closed contacts.

.4 Design Operation: Rising pressure signals water flow.

.6 Valve Supervisory Switches:

.1 ULc listed and/ or FM approved

.2 Type: Electrically supervised.

.3 Components: Single-pole, double-throw switch with normally closed contacts.

.4 Design: Signals that controlled valve is in other than fully open position.

.7 Indicator-Post Supervisory Switches:

.1 ULc listed and/ or FM approved

.2 Type: Electrically supervised.

.3 Components: Single-pole, double-throw switch with normally closed contacts.

.4 Design: Signals that controlled indicator-post valve is in other than fully open position.

2.8 PRESSURE GAUGES

.1 ULc listed and/ or FM approved

.2 Dial Size: 90-to-115-mm (3-1/2- to 4-1/2-inch) diameter.

.3 Pressure Gauge Range: 0-to-1725-kPa (0 -to 250-psig) minimum.

.4 Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.

.5 Air System Piping Gauge: Include "AIR" or "AIR/WATER" label on dial face

3 Execution

3.1 PREPARATION

.1 Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

.2 Report test results promptly and in writing.

3.2 PAINTING, LABELING AND IDENTIFICATION

.1 Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14 and or other labeling and painting contractual requirements.

.2 Refer to 20 05 00 – General Mechanical Requirements and to Architectural Division for painting requirements prior to finalizing painting plan.

3.3 EXAMINATION

.1 Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

.2 Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 SERVICE-ENTRANCE PIPING

.1 All underground fire suppression piping outside the building footprint (from the outside of the foundation wall to the property line) shall be covered by the civil discipline.

.2 Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories at connection to fire-suppression water-service piping. Comply with requirements for backflow preventers in Section 21 13 13 “Wet Pipe Sprinkler Systems.”

3.5 PIPING INSTALLATION

.1 Pipe, unless otherwise specified, is to be as follows:

.1 For underground pipe inside the building - Ipex "Blue Brute" Class 200, DR14 rigid PVC, braced and secured at bends and tees with concrete blocks in accordance with Municipal standards and details, and complete with No. 14 gge solid copper plastic insulated wire secured to the top of the pipe for the entire length of the pipe fastened with plastic type ties for pipe location tracing purposes. Lay pipes true to line and grade with bells upgrade. Fit sections together so that, when complete, the pipe has a smooth and uniform invert. Keep pipe thoroughly clean so that jointed compound will adhere. Inspect the pipe for defects before being lowered into the trench. Do not use defective pipe. All non ferrous piping shall be changed to ferrous piping prior to entering the building using an EBAA iron Inc. Mega-Coupling Series 3800 or equivalent. (i.e., changed before passing through basement floor or slab on grade).

.2 For all underground ductile iron pipe provide Polyethylene Film: ANSI/AWWA C105/A21.5 with minimum nominal thickness of 200 microns and minus tolerance with 10 percent. Provide tubes for straight pipe and sheets for fittings or tees. Securing tape: Thermoplastic material with minimum thickness 200 microns, width 25mm, and pressure sensitive adhesive face capable of bonding to metal, bituminous coating and polyethylene

.3 For piping inside building and above ground from service connection to discharge side of alarm valve, etc. - Schedule 40 grooved end black steel with Victaulic fittings and coupling joints, or, for piping to and including 50 mm (2 inch) diameter, screwed fittings and joints or piping 65 mm (2-1/2 inch) diameter and larger, welding fittings and welded joints.

.4 For pipe inside building and above ground to exterior pump test hose valve header and for fire department connection - Schedule 40 black steel as above.

.5 For piping downstream of "head end" alarm valve(s) and equipment – Schedule 10 black steel pipe with Victaulic fittings and coupling joints or screwed fittings and joints.

.6 Galvanized for Dry Piping and Pre-Action System Piping.

.2 Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

.1 Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Contract Administrator before deviating from approved working plans.

.3 Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.

.4 Install seismic restraints on piping. Comply with requirements in NFPA and Section 20 05 50 – Seismic Restraint System for seismic-restraint device materials and installation, as applicable.

.5 Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

.6 Install drain valves on standpipes. Extend drain piping to outside of building.

.7 Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.

.8 Install alarm devices in piping systems.

.9 Install hangers and supports for standpipe system piping in accordance with NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

.10 Install pressure gauges on riser or feed main and at top of each standpipe. Include pressure gauges with connection of not less than DN 80 (NPS 1/4) and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.

.11 Drain dry-type standpipe system piping.

.12 Pressurize and check dry-type standpipe system piping and air compressors.

.13 Fill wet-type standpipe system piping with water.

.14 Install pipe insulation on wet-type fire-suppression standpipe piping in areas subject to freezing. Section 20 07 00 -Mechanical Insulation.

.15 Install sleeves for piping penetrations of walls, ceilings, and floors.

.16 Install sleeve seals for piping penetrations of concrete walls and slabs.

.17 Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.6 JOINT CONSTRUCTION

.1 Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

.2 Install unions adjacent to each valve in pipes DN 50 (NPS 2) and smaller.

.3 Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having DN 65 (NPS 2-1/2) and larger end connections.

.4 Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

.5 Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

.6 Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts in accordance with ASME B31.9.

.7 Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

.1 Apply appropriate tape or thread compound to external pipe threads.

.2 Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

.8 Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe joints.

.9 Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.

.10 Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

.1 Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

.11 Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.7 VALVE AND SPECIALTIES INSTALLATION

.1 Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties in accordance with NFPA 14, authorities having jurisdiction and manufacturer's instructions.

.2 Install listed fire-protection supervised-open shutoff valves, located to control sources of water supply, except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

.3 Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

.4 Specialty Valves:

.1 General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

.2 Alarm Valves: Install bypass check valve and retarding chamber drain-line connection.

3.8 HOSE CONNECTIONS (CABINETS) INSTALLATION

.1 Install hose connections adjacent to standpipes, unless otherwise indicated

.2 Standpipe hose connections shall be installed between 0.91 m and 1.52 m (3 ft. and 5 ft.) AFF.

.3 Install hose connections for access and minimum passage restriction.

.4 Install hose connections with threaded reducers adapter, unless otherwise indicated.

.5 Install all hose connections in cabinets. Include pipe escutcheons, witch finish matching valves, inside and outside where water-supply piping penetrates cabinets. Install valves at angle required for connection of fire hose.

.6 Install surface mounted fire hose cabinets in process and industrial areas or located in humid and corrosive locations on floor mounted Type 316 stainless steel structural frameworks where shown.

3.9 IDENTIFICATION

.1 Install labeling and pipe markers on equipment and piping in accordance with NFPA 14 requirements and or other labeling and painting contractual requirements.

.2 Identify system components, wiring, cabling, and terminals. Follow the same identification requirements as those specified for the Fire Alarm System.

3.10 FIELD QUALITY CONTROL

.1 Perform tests and inspections.

.2 Tests and Inspections:

.1 Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

.2 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

.3 Flush, test, and inspect standpipe systems in accordance with NFPA 14, "System Acceptance" chapter.

.4 Energize circuits to electrical equipment and devices.

.5 Start and run air compressors.

.6 Coordinate with fire-alarm tests. Operate as required.

.7 Coordinate with fire-pump tests. Operate as required.

.8 Verify that equipment hose threads are same as local fire-department equipment.

.3 Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.

.4 Prepare test and inspection reports.

3.11 CHEMICAL RESISTANT CORROSION COATING

.1 All exposed piping and equipment installed in the areas subject to water spray, humid and or corrosive environment locations shall be treated, painted and coated with chemical resistant base and top coatings in accordance with the Sections 099000 and 099656.

3.12 DEMONSTRATION

.1 Engage a factory-authorized service representative to Train City's maintenance personnel to adjust, operate, and maintain standpipe systems.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:

.1 Pipes, fittings, and specialties.

.2 Cover system for sprinkler piping.

.3 Specialty valves.

.4 Sprinklers.

.5 Alarm devices.

.6 Manual control stations.

.7 Control panels.

.8 Pressure gauges.

.9 Fire extinguishers

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements

.2 Section 20 05 4 – Vibration Isolation

.3 Section 20 05 50 – Seismic Restraint System.

.4 Section 20 07 00 – Mechanical Insulation

.5 Section 21 05 23 – General-Duty Valves for Water-Based Fire-Suppression Piping.

.6 Section 21 13 13 – Wet-Pipe Sprinkler Systems.

.7 Section 21 13 16 – Dry-Pipe Sprinkler Systems.

.8 Section 21 30 00 – Fire Pump

1.3 REFERENCE STANDARDS

.1 ANSI

.1 ANSI/ASA S3.41 Audible Emergency Evacuation (E2) and Evacuation Signals with Relocation Instructions (ESRI)

.2 ASME

.1 2010 ASME Boiler and Pressure Vessel Code

.2 ASME B1.20.1 Pipe Threads, General Purpose, Inch

.3 ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings

.4 ASME B16.4 Cast Iron Threaded Fittings

.5 ASME B16.5 Pipe Flanges and Flanged Fittings

.6 ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings

.7 ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

.8 ASME B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings

.9 ASME B31.9 Building Services Piping

.10 ASME B36.10M Welded and Seamless Wrought Steel Pipe

.3 ASTM

.1 ASTM A47/A47M Standard Specification for Ferritic Malleable Iron Castings

.2 ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.3 ASTM A135/A135M Standard Specification for Electric-Resistance-Welded Steel Pipe

.4 ASTM A234/A234M Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

.5 ASTM A536 Standard Specification for Ductile Iron Castings

.6 ASTM A733 Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

.7 ASTM A795/A795M Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

.8 ASTM A865/A865M Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints

.9 ASTM B75/B75M Standard Specification for Seamless Copper Tube

.10 ASTM B88 Standard Specification for Seamless Copper Water Tube

.11 ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications

.12 ASTM F2014 Standard Specification for Non-Reinforced Extruded Tee Connections for Piping Applications.

.13 ASTM F438 Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40

.14 ASTM F439 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

.15 ASTM F402 Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

.16 ASTM F442/F442M Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR–PR)

.17 ASTM F493 Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

.18 ASTM F2014 Standard Specification for Non-Reinforced Extruded Tee Connections for Piping Applications

.19 ASTM D2846/D2846M Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems

.4 AWS

.1 AWS A5.8M/A5.8 Specification For Filler Metals For Brazing And Braze Welding

.2 AWS D10.12M/D10.12 Guide For Welding Mild Steel Pipe-American Welding Society

.5 AWWA

.1 AWWA C606 Standard for Grooved and Shouldered Joints

.2 AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings

.6 CSA

.1 CSA Z245.30 – Field-applied external coatings for steel pipeline systems.

.7 ISO

.1 ISO 8201 Alarm systems — Audible emergency evacuation signal — Requirements

.8 MSS

.1 MSS SP-123 Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube

.9 NFPA

.1 NFPA 10 Standard for Portable Fire Extinguishers

.2 NFPA 13 Standard for the Installation of Sprinkler Systems

.3 NFPA 13R Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies

.4 NFPA 70 National Electrical Code

.5 NFPA 291 NFPA 291 Recommended Practice for Fire Flow Testing and Marking of Hydrants

.10 ULC listed and/ or FM approved

.11 National Building Code

.12 National Fire Code

.13 AN/ULC-S524 (Standard for the Installation of Fire Alarm Systems)

.14 CAN/ULC-S537 (Standard for the Verification of Fire Alarm Systems)

1.4 DEFINITIONS

.1 High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 1200-Kpa (175 psig), but not higher than 1725-kPa (250 psig).

.2 Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 1200-kPa (175-psig) maximum.

1.5 ACTION SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data: For each type of product.

.1 Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

.3 Sustainable Design Submittals:

.4 Shop Drawings: For wet-pipe sprinkler systems.

.1 Include plans, elevations, sections, and attachment details.

.2 Include diagrams for power, signal, and control wiring.

.5 Retain a Licensed Professional Engineer, with experience in Work of comparable complexity and scope, to perform the following services as part of the Work of this Section:

.1 Design of system and sizing calculations.

.2 Review, stamp, and sign shop drawings and design calculations.

.3 Monitor and report on manufacturer's quality control tests and reports for compliance with Contract Documents.

.6 Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Licensed Professional Engineer, responsible for their preparation.

.7 Regulatory requirements:

.1 Prior to purchase and installation of sprinkler system, submit documents to authority having jurisdiction and obtain their approval.

.2 Make submissions to authority having jurisdiction well in advance so as not to delay installation.

1.6 INFORMATIONAL SUBMITTALS

.1 Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

.1 Domestic water piping.

.2 Compressed air piping.

.3 HVAC hydronic piping.

.4 Items penetrating finished ceiling include the following:

.1 Lighting fixtures.

.2 Air outlets and inlets.

.5 All electrical.

.2 Qualification Data: For qualified Installer and Licensed Professional Engineer.

.3 Design Data:

.1 Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

.4 Seismic Qualification Data:

.1 Post disaster facility, as applicable.

.5 Welding certificates.

.6 Field Test Reports:

.1 Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

.2 Fire-hydrant flow test report.

.7 Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

.1 Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

.1 Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.9 QUALITY ASSURANCE

.1 Installer Qualifications:

.1 Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

.1 Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified Licensed Professional Engineer.

.2 Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.10 FIELD CONDITIONS

.1 Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by City or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

.1 Notify Construction Contractor no fewer than two days in advance of proposed interruption of sprinkler service.

.2 Do not proceed with interruption of sprinkler service without Construction Manager's/City's written permission.

2 Products

2.1 PERFORMANCE REQUIREMENTS

.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

.2 Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.

.3 Standard-Pressure Piping System Component: Listed for 1200-kPa (175-psig) minimum working pressure.

.4 High-Pressure Piping System Component: Listed for 1725-kPa (250-psig) minimum working pressure.

.5 Delegated Design: Engage a qualified Professional Engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

.1 Sprinkler system design shall be approved by authorities having jurisdiction.

.1 Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

.2 Maximum Protection Area per Sprinkler:

.1 In according to NFPA 13 recommendations unless otherwise indicated.

.6 Seismic Performance: See Section 20 05 50 – Seismic Restraint System, as applicable.

2.2 STEEL PIPE AND FITTINGS

.1 PVC: Ipex "Brute Brute " Class 200, DR14, rigid, hub and spigot pattern PVC pipe and CSA certified fittings to CSA B137.2 and B137.3, ULC listed and FM approved and complete with gasketed joints.

.2 Stainless Steel – Welded Joint: Type 304/316 Schedule 40, ASTM 312, mill or site beveled, complete with factory made seamless stainless steel, butt welding fittings to ASTM A403M & ASME B16.9, long sweep pattern wherever possible, and welded joints. For underground applications piping shall be wrapped in one of the following corrosion-resistant systems:

.1 PVC Pipe Tape: Minimum 0.25 mm (10 mil) thick, suitable for direct burial, and provide resistance from corrosion by means of water (moisture), salts, alkalis, dielectric contact, and soil acids. Wrap system shall also resist growth of bacteria/fungus, abrasion, and UV (sunlight).

.2 Petrolatum Based Wrap: Product shall be suitable for direct burial and consist of petrolatum based tape, primer, and mastic (where contouring is necessary). Wrap system shall be designed to provide long term corrosion protection, and will not crack, peel, or harden over time. Product shall remain impermeable to moisture after burial and/or submersion in water. System shall be certified to CSA Z245.30.

.3 Schedule 40 Steel - Grooved Coupling Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with mill or site roll grooved ends, and Victaulic "Fire Lock" or "FIT Style 960 fittings", Gruvlock Fig. #7105 "Sock-It" fittings, Tyco Fire Suppression & Building Products Mechanical Outlet Tee Fig. 730 and Victaulic Style 005, Tyco Fire Suppression & Building Products #772, Gruvlok Rigid-Lite #7400, Shurjoint "Speed"or "Z05" rigid coupling joints or approved equivalent. Snap-Let type or strap type fittings are not acceptable.

.4 Schedule 40 Steel - Screwed and Welded Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B. Screwed piping is to be complete with Class 125 cast iron screwed fittings to ANSI/ASME B16.4. Welded piping is to be complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, long sweep pattern wherever possible.

.5 Schedule 10 Steel - Grooved Coupling Joints: Schedule 10 mild black carbon steel, ASTM A53, Grade B, or ASTM A795, Grade A, complete with mill or site roll grooved ends, and Victaulic "Fire Lock" fittings, Tyco Fire Suppression & Building Products grooved fittings and Victaulic Style 005, Tyco Fire Suppression & Building Products #772, Gruvlok Rigid-Lite #7400 rigid coupling joints or approved equivalent. Snap-Let type or strap type fittings are not acceptable.

2.3 SERVICE MAIN REDUCED PRESURE ZONE DETECTOR ASSEMBLY

.1 Minimum 2005 kPa (175 psi) rated, ULC listed and FM approved reduced pressure zone backflow preventer assembly (with shut-off valves) to CAN/CSA B64, complete with test cocks, and piping by-pass assembly with water meter. Acceptable products are:

.1 Watts Series 957 RPDA

.2 Zurn/Wilkins 375DA Series

2.4 COVER SYSTEM FOR SPRINKLER PIPING

.1 Description: System of support brackets and covers made to protect sprinkler piping.

.2 Brackets: Glass-reinforced nylon.

2.5 SPECIALTY VALVES

.1 ULc listed and/ or FM approved

.2 Pressure Rating:

.1 Standard-Pressure Piping Specialty Valves: 1200-kPa (175-psig) minimum.

.2 High-Pressure Piping Specialty Valves: 1725-kPa (250-psig) minimum.

.3 Body Material: Cast or ductile iron.

.4 Size: Same as connected piping.

.5 End Connections: Flanged or grooved.

.6 Alarm Valves:

.1 ULc listed and/ or FM approved

.2 Design: For horizontal or vertical installation.

.3 Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.

.4 Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

.5 Drip Cup Assembly: Pipe drain with check valve to main drain piping.

.6 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

.7 Deluge Valves:

.1 ULc listed and/ or FM approved

.2 Design: Hydraulically operated, differential-pressure type.

.3 Include trim sets for alarm-test bypass, drain, electrical water-flow alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, and fill-line attachment with strainer.

.4 Wet, Pilot-Line Trim Set: Include gage to read diaphragm-chamber pressure and manual control station for manual operation of deluge valve, and connection for actuation device.

.8 Automatic (Ball Drip) Drain Valves:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 1200-kPa (175-psig) minimum.

.3 Type: Automatic draining, ball check.

.4 Size: DN 20 (NPS 3/4).

.5 End Connections: Threaded.

2.6 AIR VENT

.1 Manual Air Vent/Valve:

.1 Description: Ball valve that requires human intervention to vent air.

.2 Body: Forged brass.

.3 Ends: Threaded.

.4 Minimize Size: 13 mm (1/2 inch).

.5 Minimum Water Working Pressure Rating: 2070-kPa (300 psig).

.2 Automatic Air Vent:

.1 Description: Automatic air vent that automatically vents trapped air without human intervention.

.2 Standard: ULc listed or FM Global approved for use in wet-pipe fire sprinkler systems.

.3 Vents oxygen continuously from system.

.4 Float valve to prevent water discharge.

.5 Minimum Water Working Pressure Rating: 1207-kPa (175-psig).

.3 Automatic Air Vent Assembly:

.1 Description: Automatic air vent assembly that automatically vents trapped air without human intervention, including Y-strainer and ball valve in a pre-piped assembly.

.2 Standard: ULc listed or FM Global approved for use in wet-pipe fire sprinkler system.

.3 Vents oxygen continuously from system.

.4 Float valve to prevent water discharge.

.5 Minimum Water Working Pressure Rating: 1207-kPa (175-psig).

2.7 SPRINKLER PIPING SPECIALTIES

.1 Branch Outlet Fittings:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 1200-kPa (175-psig) minimum.

.3 Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.

.4 Type: Mechanical-tee and -cross fittings.

.5 Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.

.6 Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

.7 Branch Outlets: Grooved, plain-end pipe, or threaded.

.2 Flow Detection and Test Assemblies:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 1200-kPa (175-psig) minimum.

.3 Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

.4 Size: Same as connected piping.

.5 Inlet and Outlet: Threaded or grooved.

.3 Branch Line Testers:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 175 psig (1200 kPa).

.3 Body Material: Brass.

.4 Size: Same as connected piping.

.5 Inlet: Threaded.

.6 Drain Outlet: Threaded and capped.

.7 Branch Outlet: Threaded, for sprinkler.

.4 Sprinkler Inspector's Test Fittings:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 1200-kPa (175-psig) minimum.

.3 Body Material: Cast- or ductile-iron housing with sight glass.

.4 Size: Same as connected piping.

.5 Inlet and Outlet: Threaded.

.5 Adjustable Drop Nipples:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 1725-kPa (250-psig) minimum.

.3 Body Material: Steel pipe with EPDM-rubber O-ring seals.

.4 Size: Same as connected piping.

.5 Length: Adjustable.

.6 Inlet and Outlet: Threaded.

.6 Flexible Sprinkler Hose Fittings:

.1 ULc listed and/ or FM approved

.2 Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.

.3 Pressure Rating: 1200-kPa (175-psig) minimum.

.4 Size: Same as connected piping, for sprinkler.

2.8 SPRINKLERS

.1 ULc listed and/ or FM approved

.2 Pressure Rating for Residential Sprinklers: 175-psig (1200-kPa) maximum.

.3 Pressure Rating for Automatic Sprinklers: 175-psig (1200-kPa) minimum.

.4 Pressure Rating for High-Pressure Automatic Sprinklers: 1725-kPa (250-psig) minimum.

.5 Automatic Sprinklers with Heat-Responsive Element:

.1 ULc listed and/ or FM approved

.2 Characteristics: Nominal 12.7-mm (1/2-inch) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

.6 Open Sprinklers with Heat-Responsive Element Removed:

.1 Nominal Orifice: 12.7-mm (1/2 inch), with discharge coefficient K 5.3.

.2 Nominal Orifice: 13.5-mm (17/32 inch) with discharge coefficient K 7.4.

.7 Sprinkler Finishes:

.1 Pendent: Chrome plated.

.2 Upright: Brass body.

.8 Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

.1 Ceiling Mounting: Chrome-plated steel, two piece, with 25-mm (1-inch) vertical adjustment or as required

.2 Sidewall Mounting: Chrome-plated steel, one piece, flat or as required.

.9 Sprinkler Guards:

.1 ULc listed and/ or FM approved

.2 Type: Wire cage with fastening device for attaching to sprinkler.

2.9 ALARM DEVICES

.1 Alarm-device types shall match piping and equipment connections.

.2 Water-Motor-Operated Alarm:

.1 ULc listed and/ or FM approved

.2 Type: Mechanically operated, with Pelton wheel.

.3 Alarm Gong: Cast aluminum with red-enamel factory finish.

.4 Size: 216-mm (8-1/2-inches) diameter.

.5 Components: Shaft length, bearings, and sleeve to suit wall construction.

.6 Inlet: DN 20 (NPS 3/4).

.7 Outlet: DN 25 (NPS 1) drain connection.

.3 Electrically Operated Notification Appliances:

.1 Electric Bell:

.1 ULc listed and/ or FM approved

.2 Type: Vibrating, metal alarm bell.

.3 Size: 150-mm (6-inch) minimum diameter.

.4 Voltage: 120 V ac, 60 Hz, 1 phase.

.5 Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.

.2 Strobe/Horn:

.1 ULc listed and/ or FM approved

.2 Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.

.3 Voltage: 120 V ac, 60 Hz.

.4 Effective Intensity: 110 cd.

.5 Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."

.6 Sign, Integrated: Mount between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Housing to be shaped to cover surface-mounted weatherproof backbox. Sign is to consist of white lettering on red plastic identifying it as a "Sprinkler Fire Alarm" and instructing viewers to call 911, police, or fire department.

.4 Water-Flow Indicators:

.1 ULc listed and/ or FM approved

.2 Water-Flow Detector: Electrically supervised.

.3 Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

.4 Type: Paddle operated.

.5 Pressure Rating: 1725-kPa (250-psig).

.6 Design Installation: Horizontal or vertical.

.5 Pressure Switches:

.1 ULc listed and/ or FM approved

.2 Type: Electrically supervised water-flow switch with retard feature.

.3 Components: Single-pole, double-throw switch with normally closed contacts.

.4 Design Operation: Rising pressure signals water flow.

.6 Valve Supervisory Switches:

.1 ULc listed and/ or FM approved.

.2 Type: Electrically supervised.

.3 Components: Single-pole, double-throw switch with normally closed contacts.

.4 Design: Signals that controlled valve is in other than fully open position.

.5 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.10 MANUAL CONTROL STATIONS

.1 ULc listed and/ or FM approved for hydraulic operation, with union, DN 15 (NPS 1/2) pipe nipple, and bronze ball valve.

.2 Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.11 CONTROL PANELS

.1 Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.

.1 ULc listed and/ or FM approved when used with thermal detectors and Class A detector circuit wiring.

.2 Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.

.3 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

.2 Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

.3 Manual Control Stations: Hydraulic operation, with union, DN 15 (NPS 1/2) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

.4 Panels Components:

.1 Power supply.

.2 Battery charger.

.3 Standby batteries.

.4 Field-wiring terminal strip.

.5 Electrically supervised solenoid valves and polarized fire-alarm bell.

.6 Lamp test facility.

.7 Single-pole, double-throw auxiliary alarm contacts.

.8 Rectifier.

2.12 PRESSURE GAUGES

.1 ULc listed and/ or FM approved

.2 Dial Size: 90-to-115-mm (3-1/2- to 4-1/2-inch) diameter.

.3 Pressure Gauge Range: 0-to-1725-kPa (0- to 250-psig) minimum.

.4 Label: Include "WATER" label on dial face.

2.13 FIRE EXTINGUISHERS - GENERAL

.1 All fire extinguishers are to be pressurized (stored pressure) rechargeable type, in accordance with NFPA 10, and ULC listed and labelled for the class of fires for which they are specified.

.2 Each extinguisher is to be complete with:

.1 a manufacturer's identification label indicating the extinguisher model number, rating, and operating instructions

.2 an anodized aluminum or chrome plated forged brass valve with positive squeeze grip on-off operation and a pull-pin safety lock

.3 discharge hose with nozzle or horn and hose securing clip

.4 for wall mounted extinguishers, a wall mounting bracket

.3 Fire extinguishers in fire hose cabinets shall be supplied with the cabinet

2.14 2-A RATED WATER EXTINGUISHERS

.1 Water extinguishers are to be 175 mm (7") diameter, 9.5 L (2 gal.) capacity, each complete with a polished stainless steel cylinder with tire valve for pressuring and a waterproof stainless steel pressure gauge.

2.15 10-B.C. RATED CARBON DIOXIDE EXTINGUISHERS

.1 Carbon dioxide extinguishers are to be 170 mm (6 ¾") diameter, 6.8 kg (15 lb.), each complete with an aluminum cylinder with a safety red baked enamel finish.

2.16 3-A, 10-B.C. RATED DRY CHEMICAL EXTINGUISHERS

.1 Multi-purpose dry chemical (ammonium phosphate) extinguishers are to be 100 mm (4") diameter, 2.27 Kg (5 lb.) each complete with a steel cylinder with a safety red baked enamel finish and a waterproof stainless steel pressure gauge.

2.17 10-A, 120-B.C. RATED DRY CHEMICAL EXTINGUISHERS

.1 Multi-purpose dry chemical (ammonium phosphate) extinguishers are to be 181 mm (7-1/8") diameter, 9.08 Kg (20 lb.) each complete with a steel cylinder with a safety red baked enamel finish and a waterproof stainless steel pressure gauge.

2.18 FIRE EXTINGUISHER CABINETS

.1 Surface Mounted: Rectangular break-glass type, enclosure constructed of 1.2 mm (18 gge) corrosion resistant steel with a baked enamel finish (colour by Contract Administrator), front glass panel, break-glass mechanism, and keyed alike cylinder lock.

.1 Minimum size: 267 mm x 600 mm x 165 mm (10 ½" x 24" x 6 ½") for 5 lbs ABC Dry Chemical Extinguishers

.2 Minimum size: 359 mm x 765 mm x 230 mm (14-1/8" x 30-1/8" x 9-1/16") for 20 lbs ABC Dry Chemical Extinguishers

.2 Recessed: Rectangular cabinet with a 1.2 mm (18 gge) corrosion resistant white enamelled steel tub, 1.9 mm (14 gge) cleaned and prime coat painted steel door (colour by Contract Administrator) and adjustable trim assembly with rounded corners, semi-concealed piano hinge, safety glass panel, and flush stainless steel door latch.

.1 Minimum size: 200 mm x 435 mm x 125 mm (8" x 17" x 5") for 5 lbs. ABC Dry Chemical Extinguishers

.2 Minimum size: 230 mm x 675 mm x 200 mm (9" x 27" x 8") for 20 lbs. ABC Dry Chemical Extinguishers

.3 Semi-Recessed: Rectangular cabinet with a 1.2 mm (18 gge) corrosion resistant white enamelled steel tub, 1.9 mm (14 gge) cleaned and prime coat painted steel door (colour by Contract Administrator) and adjustable trim assembly with rounded corners, semi-concealed piano hinge, safety glass panel, and flush stainless steel door latch.

.1 Minimum size: 200 mm x 435 mm x 125 mm (8" x 17" x 5") for 5 lbs. ABC Dry Chemical Extinguishers

.2 Minimum size: 365 mm x 750 mm x 100 mm (14-1/8" x 30-1/8" x 9-1/16") for 20 lbs. ABC Dry Chemical Extinguishers

.4 Outdoor Surface Mounted: Rectangular, ABS cabinet, dent, rust and corrosion proof complete with brass lock, cover and labels.

2.19 FIRE BLANKETS

.1 Equal to National Fire Equipment Ltd. Model #FB-6078 “BATTLEBLAZE” 1500 mm x 2000 mm (60" x 78") non-combustible glass fibre fire blanket with straps and a Model #FB-6078-MC flush wall mounting storage cabinet with identified face.

3 Execution

3.1 PREPARATION

.1 Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

.2 Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

.1 All underground fire suppression piping outside the building footprint (from the outside of the foundation wall to the property line) shall be covered by the civil discipline.

.2 Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in this section.

3.3 PIPING INSTALLATION

.1 Pipe, unless otherwise specified, is to be as follows:

.1 For underground pipe inside the building Ipex "Blue Brute" Class 200, DR14 rigid PVC, braced and secured at bends and tees with concrete blocks in accordance with Municipal standards and details, and complete with No. 14 gge solid copper plastic insulated wire secured to the top of the pipe for the entire length of the pipe fastened with plastic type ties for pipe location tracing purposes. Lay pipes true to line and grade with bells upgrade. Fit sections together so that, when complete, the pipe has a smooth and uniform invert. Keep pipe thoroughly clean so that jointed compound will adhere. Inspect the pipe for defects before being lowered into the trench. Do not use defective pipe. All non-ferrous piping shall be changed to ferrous piping prior to entering the building using an EBAA iron Inc. Mega-Coupling Series 3800 or equivalent. (i.e., changed before passing through basement floor or slab on grade).

.2 Alternatively, for underground pipe inside the building “Stainless Steel – Welded Joint” shall be used. Pipe shall be braced and secured at bends and tees with concrete blocks in accordance with Municipal standards and details

.3 For piping inside building and above ground from service connection to discharge side of alarm valve, etc. - Schedule 40 grooved end black steel with Victaulic fittings and coupling joints, or, for piping to and including 50 mm (2 inch) diameter, screwed fittings and joints or piping 65 mm (2-1/2 inch) diameter and larger, welding fittings and welded joints.

.4 For pipe inside building and above ground to exterior pump test hose valve header and for fire department connection - Schedule 40 black steel as above.

.5 For piping downstream of "head end" alarm valve(s) and equipment – Schedule 10 black steel pipe with Victaulic fittings and coupling joints or Schedule 40 black steel with screwed fittings and joints.

.6 Galvanized for Dry Piping and Pre-Action System Piping.

.2 Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

.1 Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Contract Administrator before deviating from approved working plans.

.2 Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

.3 Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

.4 Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

.5 Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

.6 Install unions adjacent to each valve in pipes DN 50 (NPS 2) and smaller.

.7 Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having DN 65 (NPS 2-1/2) and larger end connections.

.8 Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

.9 Install sprinkler piping with drains for complete system drainage.

.10 Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

.11 Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

.12 Install alarm devices in piping systems.

.13 Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 20 05 50 – Seismic Restraint System.

.14 Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than DN 8 (NPS 1/4) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

.15 Pressurize and check preaction sprinkler system piping.

.16 Fill sprinkler system piping with water.

.17 Install pipe insulation on wet-type fire-suppression and standpipe piping in areas subject to freezing. Section 20 07 00 – Mechanical Insulation.

.18 Install sleeves for piping penetrations of walls, ceilings, and floors.

.19 Install sleeve seals for piping penetrations of concrete walls and slabs.

.20 Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

.1 Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

.2 Install unions adjacent to each valve in pipes DN 50 (NPS 2) and smaller.

.3 Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having DN 65 (NPS 2-1/2) and larger end connections.

.4 Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

.5 Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

.6 Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

.7 Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

.1 Apply appropriate tape or thread compound to external pipe threads.

.2 Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

.8 Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

.9 Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

.10 Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

.1 Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

.11 Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

.12 Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

.13 Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

.14 Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF REDUCED PRESURE ZONE DETECTOR ASSEMBLY

.1 Provide a detector check valve with water meter and connecting piping inside the detector check valve assembly enclosure where shown. Confirm exact location prior to installation.

.2 Equip the assembly with inlet and outlet supervised shut-off valves.

.3 Support each end of the assembly from the floor by means of a flanged pipe support with saddles.

.4 Connect electrical and control wiring as per electrical drawings.

3.6 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

.1 Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

3.7 VALVE AND SPECIALTIES INSTALLATION

.1 Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

.2 Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

.3 Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

.4 Specialty Valves:

.1 Install valves in vertical position for proper direction of flow, in main supply to system.

.2 Install alarm valves with bypass check valve and retarding chamber drain-line connection.

.3 Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

.5 Air Vent:

.1 Provide at least one air vent at high point in each wet-pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.

.2 Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.

.3 Pipe from outlet of air vent to drain

3.8 SPRINKLER INSTALLATION

.1 Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

.2 Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

.3 Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.9 IDENTIFICATION

.1 Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and or other labeling and painting contractual requirements.

.2 Identify system components, wiring, cabling, and terminals. Follow the same identification requirements as those specified for the Fire Alarm System.

3.10 FIELD QUALITY CONTROL

.1 Perform the following tests and inspections with the assistance of a factory-authorized service representative:

.1 Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

.2 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

.3 Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

.4 Energize circuits to electrical equipment and devices.

.5 Coordinate with fire-alarm tests. Operate as required.

.6 Coordinate with fire-pump tests. Operate as required.

.7 Verify that equipment hose threads are same as local fire department equipment.

.2 Sprinkler piping system will be considered defective if it does not pass tests and inspections.

.3 Prepare test and inspection reports.

3.11 CLEANING

.1 Clean dirt and debris from sprinklers.

.2 Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.12 FIELD PAINTING

.1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.

.2 Apply coatings to clean, dry surfaces, using clean brushes.

.3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.

.4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.

.5 Shield sprinkler heads with protective covering while painting is in progress.

.6 Upon completion of painting, remove protective covering from sprinkler heads.

.7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.

.8 Provide primed surfaces, piping, valves and operating accessories with two coats of paint to match adjacent surfaces, finish with 2 coats of colour (refer to City requirements for colour code/ chart) alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil each.

.9 Refer to 20 05 00 – General Mechanical Requirements and to Architectural Division for painting requirements prior to finalizing painting plan.

3.13 DEMONSTRATION

.1 Engage a factory-authorized service representative to train Project Co and City's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.14 SPRINKLER SCHEDULE

.1 Use sprinkler types in subparagraphs below for the following applications:

.1 Quick response sprinklers shall be utilized throughout the project, unless otherwise required by NFPA 13 Installation of Sprinkler Systems.

.2 Rooms without Ceilings: Upright sprinklers or as indicated.

.3 Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers or as indicated.

.4 Wall Mounting: Sidewall sprinklers, or as indicated

.5 Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers or as indicated.

.6 Deluge-Sprinkler Systems: Upright and pendent, open sprinklers or as indicated.

.7 Special Applications: Extended-coverage, flow-control, and quick-response sprinklers or as indicated.

.8 High temperature (generator room and similar high temperature areas).

.9 A listed and approved window sprinkler system shall be provided at glazed areas such as corridor doors where necessary to maintain required fire ratings.

3.15 INSTALLATION OF FIRE EXTINGUISHERS

.1 Provide fire extinguishers of the type(s) indicated in the locations shown on the drawings, and in accordance with NFPA 10:

.1 Type 3-A:10-B:C, 5 lbs. Dry Chemical Extinguishers in Light Hazard Occupancies

.2 Type 10-A:120-B:C, 20 lbs. Dry Chemical Extinguishers in Ordinary or Extra Hazard Occupancies. If a fire extinguisher is not located directly inside an Ordinary or Extra Hazard Occupancy the closest fire extinguisher to the space, within 15.25m (50 ft) walking distance, shall be Type 10-A:120-B:C, 20 lbs. Dry Chemical Extinguishers).

.2 All wall mounted extinguishers shall be installed inside an appropriately sized cabinet (not exposed on a wall bracket).

.3 Do not install extinguishers until after wall finishing work is complete.

.4 You will be responsible for fire extinguishers until after issue and receipt of a Certificate of Substantial Performance of the Work.

.5 If extinguishers are indicated adjacent door, locate the extinguishers at the strike side of the door.

.6 Fire extinguishers having a gross weight not exceeding 18.14 kg (40 lb) shall be installed so that the top of the fire extinguisher is not more than 1.53 m (5 f t) above the floor.

.7 Fire extinguishers having a gross weight greater than 18.14 kg (40 lb) shall be installed so that the top of the fire extinguisher is not more than 1.07 m (3½ ft) above the floor.

.8 In no case shall the clearance between the bottom of the fire extinguisher and the floor be less than 102 mm. (4 in).

3.16 INSTALLATION OF FIRE EXTINGUISHER CABINETS

.1 Provide surface mounted wall cabinets for fire extinguishers where shown. Provide recessed wall cabinets for fire extinguishers where shown. In locations where recessed wall cabinets will not fit into the wall cavity provide semi-recessed cabinets.

.2 Unless otherwise shown or specified, locate cabinets so that the centerline is approximately 1200 mm (48") above the finished floor.

.3 Confirm exact locations prior to installation.

3.17 INSTALLATION OF FIRE BLANKETS

.1 Provide fire blankets where shown. Store each blanket in a flush wall mounted cabinet. Confirm exact locations prior to installation.

3.18 CHEMICAL RESISTANT CORROSION COATING

.1 All exposed piping and equipment installed in the areas subject to water spray, humid and or corrosive environment locations shall be treated, painted and coated with chemical resistant base and top coatings in accordance with the Sections 099000 and 099656.

3.19 DEMONSTRATION

.1 Engage a factory-authorized service representative to Train City's maintenance personnel to adjust, operate, and maintain sprinkler systems.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:

.1 Pipes, fittings, and specialties.

.2 Specialty valves.

.3 Sprinkler specialty pipe fittings.

.4 Sprinklers.

.5 Alarm devices.

.6 Manual control stations.

.7 Control panels.

.8 Pressure gauges.

1.2 RELATED REQUIREMENTS:

.1 Section 20 05 00 – General Mechanical Requirements

.2 Section 20 05 48 – Vibration Isolation

.3 Section 20 05 50 – Seismic Restraint System.

.4 Section 20 07 00 – Mechanical Insulation

.5 Section 21 05 23 – General-Duty Valves for Water-Based Fire-Suppression Piping.

.6 Section 21 13 13 – Wet-Pipe Sprinkler Systems.

.7 Section 21 13 16 – Dry-Pipe Sprinkler Systems.

.8 Section 21 30 00 – Fire Pump

1.3 REFERENCE STANDARDS

.1 ASME

.1 ASME B1.20.1 Pipe Threads, General Purpose, Inch

.2 ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings

.3 ASME B16.4 Cast Iron Threaded Fittings

.4 ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings

.5 ASME B16.21 Nonmetallic Flat Gaskets for Pipe Flanges

.6 ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

.7 ASME B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings

.8 ASME B31.9 Building Services Piping

.9 ASME B36.10M Welded and Seamless Wrought Steel Pipe

.2 ASTM

.1 ASTM A47/A47M Standard Specification for Ferritic Malleable Iron Castings

.2 ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.3 ASTM A135/A135M Standard Specification for Electric-Resistance-Welded Steel Pipe

.4 ASTM B75/B75M Standard Specification for Seamless Copper Tube

.5 ASTM B88 Standard Specification for Seamless Copper Water Tube

.6 ASTM A733 Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

.7 ASTM A795/A795M Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

.8 ASTM A865/A865M Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints

.9 ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications

.10 ASTM F2014 Standard Specification for Non-Reinforced Extruded Tee Connections for Piping Applications.

.3 AWS

.1 AWS A5.8M/A5.8 Specification For Filler Metals For Brazing And Braze Welding

.4 AWWA

.1 AWWA C606 Standard for Grooved and Shouldered Joints

.2 AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings

.5 ISO

.1 ISO 8201 Alarm systems — Audible emergency evacuation signal — Requirements

.6 MSS

.1 MSS SP-123 Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube

.7 NEMA

.1 NEMA 4

.2 NEMA 6P

.3 NEMA ICS

.8 NFPA

.1 NFPA 13 Standard for the Installation of Sprinkler Systems

.2 NFPA 70 National Electrical Code

.3 NFPA 291 NFPA 291 Recommended Practice for Fire Flow Testing and Marking of Hydrants

.9 ULC listed and/ or FM approved

.10 National Building Code

.11 National Fire Code

.12 AN/ULC-S524 (Standard for the Installation of Fire Alarm Systems)

.13 CAN/ULC-S537 (Standard for the Verification of Fire Alarm Systems)

1.4 DEFINITIONS

.1 Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure of 1200-kPa (175-psig) maximum.

1.5 ACTION SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data: For each type of product.

.1 Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

.3 Shop Drawings: For dry-pipe sprinkler systems.

.1 Include plans, elevations, sections, and attachment details.

.2 Include diagrams for power, signal, and control wiring.

.4 Retain Licensed Professional Engineer, with experience in Work of comparable complexity and scope, to perform the following services as part of the Work of this Section:

.1 Design of system and sizing calculations.

.2 Review, stamp, and sign shop drawings and design calculations.

.3 Monitor and report on manufacturer's quality control tests and reports for compliance with Contract Documents.

.5 Delegated-Design Submittal: For dry-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Licensed Professional Engineer, responsible for their preparation.

.6 Regulatory requirements:

.1 Prior to purchase and installation of sprinkler system, submit documents to authority having jurisdiction and obtain their approval.

.2 Make submissions to authority having jurisdiction well in advance so as not to delay installation.

1.6 INFORMATIONAL SUBMITTALS

.1 Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

.1 Domestic water piping.

.2 Compressed air piping.

.3 HVAC hydronic piping.

.4 Items penetrating finished ceiling including the following:

.1 Lighting fixtures.

.2 Air outlets and inlets.

.5 All electrical

.2 Qualification Data: For qualified Installer and Professional Engineer

.3 Design Data:

.1 Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

.4 Seismic Qualification Data:

.1 Post disaster facility, as applicable.

.5 Welding certificates.

.6 Fire-hydrant flow test report.

.7 Field Test Reports:

.1 Fire-hydrant flow test report.

.2 Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

.8 Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

.1 Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

.1 Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.9 QUALITY ASSURANCE

.1 Installer Qualifications:

.1 Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

.1 Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified Professional Engineer.

.2 Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

2 Products

2.1 SYSTEM DESCRIPTIONS

.1 Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.

.2 Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air or nitrogen. Fire-detection system, located in same area as sprinklers, actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from opened sprinklers.

.3 Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system, located in same area as sprinklers, opens pre-action valve, permitting water to flow into sprinkler piping and to discharge from opened sprinklers.

.4 Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system, located in same area as sprinklers, will activate the normally closed solenoid but will not open the pre-action valve. Activation of a sprinkler head will not permit water to flow into sprinkler piping. Activation of both the normally closed solenoid valve and automatic sprinkler is required to cause the pre-action valve to open, permitting water to flow into sprinkler piping, and water will then discharge from opened sprinkler.

2.2 PERFORMANCE REQUIREMENTS

.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

.2 Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.

.3 Standard-Pressure Piping System Component: Listed for 1200-kPa (175-psig) minimum working pressure.

.4 Delegated Design: Engage a qualified Professional Engineer, as defined in Section 01 40 00 – Quality Requirements, to design dry-pipe sprinkler systems.

.5 Sprinkler system design shall be approved by authorities having jurisdiction.

.1 Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

.2 Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

.1 Light-Hazard Occupancies: 6.3L/s (100 gpm) for 30 minutes.

.2 Ordinary-Hazard Occupancies: 15.75L/s (250 gpm) for 60 to 90 minutes.

.3 Extra-Hazard Occupancies: 31.5L/s (500 gpm) for 90 to 120 minutes.

.6 Seismic Performance: Refer to Section 20 05 50 – Seismic Restraint System, as applicable.

2.3 GALVANIZED STEEL PIPE AND FITTINGS

.1 PVC: Ipex "Brute Brute " Class 200, DR14, rigid, hub and spigot pattern PVC pipe and CSA certified fittings to CSA B137.2 and B137.3, ULC listed and FM approved and complete with gasketed joints.

.2 Schedule 40 Steel - Grooved Coupling Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with mill or site roll grooved ends, and Victaulic "Fire Lock" or "FIT Style 960 fittings", Gruvlock Fig. #7105 "Sock-It" fittings, Tyco Fire Suppression & Building Products Mechanical Outlet Tee Fig. 730 and Victaulic Style 005, Tyco Fire Suppression & Building Products #772, Gruvlok Rigid-Lite #7400, Shurjoint "Speed"or "Z05" rigid coupling joints or approved equivalent. Snap-Let type or strap type fittings are not acceptable.

.3 Schedule 40 Steel - Screwed and Welded Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B. Screwed piping is to be complete with Class 125 cast iron screwed fittings to ANSI/ASME B16.4. Welded piping is to be complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, long sweep pattern wherever possible.

.4 Schedule 10 Steel - Grooved Coupling Joints: Schedule 10 mild black carbon steel, ASTM A53, Grade B, or ASTM A795, Grade A, complete with mill or site roll grooved ends, and Victaulic "Fire Lock" fittings, Tyco Fire Suppression & Building Products grooved fittings and Victaulic Style 005, Tyco Fire Suppression & Building Products #772, Gruvlok Rigid-Lite #7400 rigid coupling joints or approved equivalent. Snap-Let type or strap type fittings are not acceptable.

2.4 PIPING JOINING MATERIALS

.1 Pipe-Flange Gasket Materials: AWWA C110/A21.10, rubber, flat face, 3.2-m (1/8 inch) thick.

.1 Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

.2 Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

.2 Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1 carbon steel unless otherwise indicated.

.3 Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 SPECIALTY VALVES

.1 ULc listed and/ or FM approved

.2 Pressure Rating:

.1 Standard-Pressure Piping Specialty Valves: 1200-kPa (175-psig) minimum.

.3 Body Material: Cast or ductile iron.

.4 Size: Same as connected piping.

.5 End Connections: Flanged or grooved.

.6 Dry-Pipe Valves:

.1 ULc listed and/ or FM approved

.2 Design: Differential-pressure type.

.3 Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

.4 Air-Pressure Maintenance Device:

.1 ULc listed and/ or FM approved

.2 Type: Automatic device to maintain minimum air pressure in piping.

.3 Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 95- to 410-kPa (14- to 60-psig) adjustable range, and 1200-kPa (175-psig) outlet pressure.

.5 Air Compressor:

.1 ULc listed and/ or FM approved

.2 Motor Horsepower:

.1 Power: 120V, 60 Hz, single phase or 575V, 60 Hz, three phase to suit system volume/ capacity/ fill time requirements.

.3 Sized for application and capable of achieving system supervisory pressure within 30 minutes in accordance with requirements of NFPA 13. Provide ASME air receiver tank as required to meet requirements on larger systems.

.4 Include filters, relief valves, coolers, automatic drains, and gauges.

.7 Pre-Action Valves:

.1 ULc listed and/ or FM approved.

.2 Design: Hydraulically operated, differential-pressure type.

.3 Include trim sets for alarm-test bypass, drain, electrical water-flow alarm switch, pressure gauges, drip cup assembly piped without valves and separate from main drain line, and fill-line attachment with strainer.

.4 Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gauges; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.

.5 Air-Pressure Maintenance Device:

.1 ULc listed and/ or FM approved

.2 Type: Automatic device to maintain minimum air pressure in piping.

.3 Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 95- to 410-kPa (14- to 60-psig) adjustable range, and 1200-kPa (175-psig) outlet pressure.

.6 Air Compressor:

.1 Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

.2 Motor Horsepower:.

.1 Power: 120V, 60 Hz, single phase or 575V, 60 Hz, three phase to suit system volume/ capacity/ fill time requirements.

.3 Sized for application and capable of achieving system supervisory pressure within 30 minutes in accordance with requirements of NFPA 13. Provide ASME air receiver tank as required to meet requirements on larger systems.

.4 Include filters, relief valves, coolers, automatic drains, and gauges.

.8 Automatic (Ball Drip) Drain Valves:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 1200-kPa (175-psig) minimum.

.3 Type: Automatic draining, ball check.

.4 Size: DN 20 (NPS ¾).

.5 End Connections: Threaded.

2.6 SPRINKLER PIPING SPECIALTIES

.1 General Requirements for Dry-Pipe System Fittings: ULc listed and/ or FM approved for dry-pipe service.

.2 Branch Outlet Fittings:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 1200-kPa (175-psig) minimum.

.3 Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.

.4 Type: Mechanical-tee and -cross fittings.

.5 Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.

.6 Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

.7 Branch Outlets: Grooved, plain-end pipe, or threaded.

.3 Flow Detection and Test Assemblies:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 1200-kPa (175-psig).

.3 Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

.4 Size: Same as connected piping.

.5 Inlet and Outlet: Threaded.

.4 Branch Line Testers:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 1200-kPa (175-psig) minimum.

.3 Body Material: Brass.

.4 Size: Same as connected piping.

.5 Inlet: Threaded.

.6 Drain Outlet: Threaded and capped.

.7 Branch Outlet: Threaded, for sprinkler.

.5 Sprinkler Inspector's Test Fittings:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 1200-kPa (175-psig) minimum.

.3 Body Material: Cast- or ductile-iron housing with sight glass.

.4 Size: Same as connected piping.

.5 Inlet and Outlet: Threaded.

.6 Adjustable Drop Nipples:

.1 ULc listed and/ or FM approved

.2 Pressure Rating: 1725-kPa (250-psig) minimum.

.3 Body Material: Steel pipe with EPDM O-ring seals.

.4 Size: Same as connected piping.

.5 Length: Adjustable.

.6 Inlet and Outlet: Threaded.

.7 Flexible Sprinkler Hose Fittings:

.1 ULc listed and/ or FM approved

.2 Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.

.3 Pressure Rating: 1200-kPa (175-psig) minimum.

.4 Size: Same as connected piping, for sprinkler.

2.7 SPRINKLERS

.1 ULc listed and/ or FM approved

.2 Pressure Rating for Automatic Sprinklers: 175-psig (1200-kPa) minimum.

.3 Pressure Rating for High-Pressure Automatic Sprinklers: 1725-kPa (250-psig) minimum.

.4 Automatic Sprinklers with Heat-Responsive Element:

.1 ULc listed and/ or FM approved

.2 Characteristics: Nominal 12.7-mm (1/2-inch) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

.5 Sprinkler Finishes:

.1 Pendent: Chrome plated.

.2 Upright: Brass body.

.6 Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

.1 Ceiling Mounting: Chrome-plated steel, two piece, with 25-mm (1-inch) vertical adjustment.

.2 Sidewall Mounting: Chrome-plated steel, one piece, flat.

.7 Sprinkler Guards:

.1 ULc listed and/ or FM approved

.2 Type: Wire cage with fastening device for attaching to sprinkler.

2.8 ALARM DEVICES

.1 Alarm-device types shall match piping and equipment connections.

.2 Water-Motor-Operated Alarm:

.1 ULc listed and/ or FM approved

.2 Type: Mechanically operated, with Pelton wheel.

.3 Alarm Gong: Cast aluminum with red-enamel factory finish.

.4 Size: 1250-mm (10-inch) diameter.

.5 Components: Shaft length, bearings, and sleeve to suit wall construction.

.6 Inlet: DN 20 (NPS ¾).

.7 Outlet: DN 25 (NPS 1) drain connection.

.3 Electrically Operated Alarm Notification Appliances:

.1 Electric Bell:

.1 ULc listed and/ or FM approved

.2 Type: Vibrating, metal alarm bell.

.3 Size: 150-mm (6-inch) minimum diameter.

.4 Voltage: 120 V ac, 60 Hz, 1 phase.

.5 Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.

.2 Strobe/Horn:

.1 Standard: UL 464 listed.

.2 Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.

.3 Voltage: 120 V ac, 60 Hz.

.4 Effective Intensity: 110 cd.

.5 Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."

.6 Sign, Integrated: Mount between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Housing to be shaped to cover surface-mounted weatherproof backbox. Sign is to consists of white lettering on red plastic identifying it as a "Sprinkler Fire Alarm" and instructing viewers to call 911, police, or fire department.

.4 Pressure Switches - Water-Flow Alarm Detection:

.1 ULc listed and/ or FM approved

.2 Type: Electrically supervised, pressure-activated water-flow switch.

.3 Components: Two single-pole, double-throw switches.

.4 Design Operation: Rising pressure to 40-kPa (6 psi) plus or minus signals water flow.

.5 Adjustability: Each switch is to be independently adjustable.

.6 Wire Separation: Pressure switch to provide separation of wiring to each switch connection to allow for low and high-volume connections to comply with NFPA 70 Article 760 requirements.

.5 Pressure Switches - Low/High Air Pressure Supervisory:

.1 ULc listed and/ or FM approved

.2 Type: Electrically supervised pressure supervisory switch.

.3 Components: Two single-pole, double-throw switches.

.4 Design Operation: Detects increase and/or decrease from normal supervisory air pressure.

.5 Adjustability: Each switch is to be independently adjustable.

.6 Wire Separation: Pressure switch shall provide for separation of wiring to each switch connection to allow for low and high voltage connections to comply with NFPA 70 Article 760 requirements.

.6 Valve Supervisory Switches:

.1 General Requirements for Valve Supervisory Switches:

.1 ULc listed and/ or FM approved

.2 Type: Electrically supervised.

.3 Design: Signals that controlled valve is in other than fully open position.

.4 Wire Terminal Designations: Indicates normal switch position when switch is properly installed on the valve and valve is fully open.

.2 Requirements for OS&Y Valve Supervisory Switches:

.1 Components: One or two single-pole, double-throw switches.

.2 NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.

.3 Visual Switch Indication: Indicates device is properly installed and OS&Y valve is fully open.

.4 Mounting Hardware: Mounting bracket to grip valve yoke and prevent movement of switch assembly on OS&Y valve.

.5 Trip Rod Length: Adjustable.

.3 Requirements for PIV and Butterfly Valve Supervisory Switches:

.1 Components: Two single-pole, double-throw switches.

.2 NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.

.3 Mounting Hardware: Removable nipple.

.4 Trip Rod Length: Adjustable.

.4 Requirements for Ball Valve Supervisory Switch:

.1 Components: One single-pole, double-throw switch.

.2 NEMA Rating: NEMA 4 enclosure suitable for mounting in any position indoors or outdoors.

.3 Mounting Hardware: Suitable for mounting directly to pipe, ball valves or backflow preventers sized from up to DN 50 (NPS 2).

2.9 MANUAL CONTROL STATIONS

.1 ULc listed and/ or FM approved for hydraulic operation, with union, DN 15 (NPS ½) pipe nipple, and bronze ball valve.

.2 Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.10 DETECTION SYSTEM

.1 Provide CSA / ULc listed and/ or FM approved complete smoke and heat detection system.

.2 Automatic & manual detection devices: Supply and install a complete electrical detection system including conduit as per Division 26 requirements, wiring, heat and/or smoke detectors, manual pull stations, and connections to auxiliary functions, alarm horns and strobes at each entrance to the area served, suited for operation in designated room/ area operation and functionality.

.3 Submit shop drawings depicting all technical information, wiring diagrams, interfaces, interlocks and layout of all devices.

.4 Notification devices and signs: Supply and install a complete notification system including conduit, wiring, and notification devices.

.5 The devices must be compatible with the release control panel.

2.11 CONTROL PANELS

.1 Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 12 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.

.1 ULc listed and/ or FM approved when used with thermal detectors and Class A detector circuit wiring.

.2 Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.

.3 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

.2 Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

.3 Manual Control Stations: Hydraulic operation, with union, DN 15 (NPS ½) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

.4 Panels Components:

.1 Power supply.

.2 Battery charger.

.3 Standby batteries.

.4 Field-wiring terminal strip.

.5 Electrically supervised solenoid valves and polarized fire-alarm bell.

.6 Lamp test facility.

.7 Single-pole, double-throw auxiliary alarm contacts.

.8 Rectifier.

2.12 PRESSURE GAUGES

.1 ULc listed and/ or FM approved

.2 Dial Size: 90-to-115-mm (3-1/2- to 4-1/2-inch) diameter.

.3 Pressure Gauge Range: 0-to-1725-kPa (0- to 250-psig) minimum.

.4 Label: Include "WATER" or "AIR/WATER" label on dial face.

.5 Air System Piping Gauge: Include "AIR" or "AIR/WATER" label on dial face.

3 Execution

3.1 PREPARATION

.1 Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

.2 Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

.1 All underground fire suppression piping outside the building footprint (from the outside of the foundation wall to the property line) shall be covered by the civil discipline.

.2 Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Section 21 13 13 – Wet Pipe Sprinkler Systems.

3.3 PIPING INSTALLATION

.1 Pipe, unless otherwise specified, is to be as follows:

.1 For underground pipe inside the building - Ipex "Blue Brute" Class 200, DR14 rigid PVC, braced and secured at bends and tees with concrete blocks in accordance with Municipal standards and details, and complete with No. 14 gge solid copper plastic insulated wire secured to the top of the pipe for the entire length of the pipe fastened with plastic type ties for pipe location tracing purposes. Lay pipes true to line and grade with bells upgrade. Fit sections together so that, when complete, the pipe has a smooth and uniform invert. Keep pipe thoroughly clean so that jointed compound will adhere. Inspect the pipe for defects before being lowered into the trench. Do not use defective pipe. All non ferrous piping shall be changed to ferrous piping prior to entering the building using an EBAA iron Inc. Mega-Coupling Series 3800 or equivalent. (i.e., changed before passing through basement floor or slab on grade).

.2 For all underground ductile iron pipe provide Polyethylene Film: ANSI/AWWA C105/A21.5 with minimum nominal thickness of 200 microns and minus tolerance with 10 percent. Provide tubes for straight pipe and sheets for fittings or tees. Securing tape: Thermoplastic material with minimum thickness 200 microns, width 25mm, and pressure sensitive adhesive face capable of bonding to metal, bituminous coating and polyethylene

.3 For piping inside building and above ground from service connection to discharge side of alarm valve, etc. - Schedule 40 grooved end black steel with Victaulic fittings and coupling joints, or, for piping to and including 50 mm (2 inch) diameter, screwed fittings and joints or piping 65 mm (2-1/2 inch) diameter and larger, welding fittings and welded joints.

.4 For pipe inside building and above ground to exterior pump test hose valve header and for fire department connection - Schedule 40 black steel as above.

.5 For piping downstream of "head end" alarm valve(s) and equipment – Schedule 10 black steel pipe with Victaulic fittings and coupling joints or Schedule 40 black steel pipe with screwed fittings and joints.

.6 Galvanized for Dry Piping and Pre-Action System Piping.

.2 Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

.1 Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Contract Administrator before deviating from approved working plans.

.2 Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

.3 Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

.4 Install seismic restraints on piping. Comply with NFPA 13 requirements and Section 20 05 50 – Seismic Restraint System for seismic-restraint device materials and installation.

.5 Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

.6 Install unions adjacent to each valve in pipes DN 50 (NPS 2) and smaller.

.7 Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having DN 65 (NPS 2-1/2) and larger end connections.

.8 Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

.9 Install sprinkler piping with drains for complete system drainage.

.10 Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

.11 Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or to outside building.

.12 Connect compressed-air supply to dry-pipe sprinkler piping.

.13 Connect air compressor to the following piping and wiring:

.1 Pressure gauges and controls.

.2 Electrical power system.

.3 Fire-alarm devices, including low-pressure alarm.

.14 Install alarm devices in piping systems.

.15 Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13. In seismic-rated areas, refer to Section 20 05 50 – Seismic Restraint System.

.16 Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than DN 8 (NPS 1/4) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gauges to permit removal and install where they are not subject to freezing.

.17 Drain dry-pipe sprinkler piping.

.18 Pressurize and check dry-pipe sprinkler system piping and air compressors.

.19 Install sleeves for piping penetrations of walls, ceilings, and floors.

.20 Install sleeve seals for piping penetrations of concrete walls and slabs.

.21 Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

.1 Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

.2 Install unions adjacent to each valve in pipes DN 50 (NPS 2) and smaller.

.3 Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having DN 65 (NPS 2-1/2) and larger end connections.

.4 Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

.5 Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

.6 Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

.7 Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

.1 Apply appropriate tape or thread compound to external pipe threads.

.2 Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

.8 Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

.9 Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

.10 Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe

.11 Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

.12 Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

.13 Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

.1 Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

3.6 VALVE AND SPECIALTIES INSTALLATION

.1 Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

.2 Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

.3 Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

.4 Specialty Valves:

.1 Install valves in vertical position for proper direction of flow, in main supply to system.

.2 Install dry-pipe valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

.1 Install air compressor and compressed-air-supply piping.

.2 Install air-pressure maintenance device with shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 95-to-410-kPa (14- to 60-psig) adjustable range; and 1200-kPa (175-psig) maximum inlet pressure.

.3 Install compressed-air-supply piping from building's compressed-air piping system.

3.7 SPRINKLER INSTALLATION

.1 Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

.2 Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

.3 Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.8 IDENTIFICATION

.1 Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and or other labeling and painting contractual requirements

.2 Identify system components, wiring, cabling, and terminals. Follow the same identification requirements as those specified for the Fire Alarm System.

3.9 FIELD QUALITY CONTROL

.1 Perform the following tests and inspections with the assistance of a factory-authorized service representative:

.1 Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

.2 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

.3 Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

.4 Energize circuits to electrical equipment and devices.

.5 Start and run air compressors.

.6 Coordinate with fire-alarm tests. Operate as required.

.7 Coordinate with fire-pump tests. Operate as required.

.8 Verify that equipment hose threads are same as local fire department equipment.

.2 Sprinkler piping system will be considered defective if it does not pass tests and inspections.

.3 Prepare test and inspection reports.

3.10 CLEANING

.1 Clean dirt and debris from sprinklers.

.2 Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.11 DEMONSTRATION

.1 Engage a factory-authorized service representative to train City's maintenance personnel to adjust, operate, and maintain specialty valves.

3.12 CHEMICAL RESISTANT CORROSION COATING

.1 All exposed piping and equipment installed in the areas subject to water spray, humid and or corrosive environment locations shall be treated, painted and coated with chemical resistant base and top coatings in accordance with the Sections 099000 and 099656.

3.13 SPRINKLER SCHEDULE

.1 Use sprinkler types in subparagraphs below for the following applications:

.1 Rooms without Ceilings: Upright sprinklers or as indicated

.2 Rooms with Suspended Ceilings: Dry pendent sprinklers, Dry recessed sprinklers or as indicated.

.3 Wall Mounting: Dry sidewall sprinklers or as indicated

.4 Spaces Subject to Freezing: Upright sprinklers.

.5 Special Applications: Extended-coverage and quick-response sprinklers or as indicated.

.6 High temperature (generator room/ enclosure and similar high temperature areas)

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:

.1 Dual Clean-agent and pre-action fire-extinguishing systems.

.2 Pipe and fittings.

.3 Valves.

.4 Extinguishing-agent containers.

.5 Fire-extinguishing clean agent.

.6 Discharge nozzles.

.7 Manifold and orifice unions.

.8 Fire control panels.

.9 Detection devices.

.10 Manual stations.

.11 Switches.

.12 Alarm devices.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements

.2 Section 20 05 48-Vibration Isolation

.3 Section 20 05 50 – Seismic Restraint System.

.4 Section 20 07 00 -Mechanical Insulation

.5 Section 21 05 23 - General-Duty Valves for Water-Based Fire-Suppression Piping.

.6 Section 21 13 13 - Wet-Pipe Sprinkler Systems.

.7 Section 21 13 16 - Dry-Pipe Sprinkler Systems.

.8 Section 21 30 00 – Fire Pump

1.3 REFERENCE STANDARDS

.1 ASME

.1 ASME Boiler and Pressure Vessel Code

.2 ASME B16.2 Metallic Gaskets for Pipe Flanges

.3 ASME B18.2.1 Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

.2 ASTM

.1 ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.2 ASTM A536 Standard Specification for Ductile Iron Castings

.3 ASTM A106/A106M Pipe Specifications

.3 AWWA

.1 AWWA C606 Grooved and Shouldered Joints

.4 AWS

.1 AWS D10.12M/D10.12 Guide for Welding Mild Steel Pipe

.5 NFPA

.1 NFPA 13 Standard for the Installation of Sprinkler Systems

.2 NFPA 70 National Electrical Code

.3 NFPA 72 National Fire Alarm and Signaling Code

.4 NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems

.6 ULC listed and/ or FM approved

.7 National Building Code

.8 National Fire Code

.9 AN/ULC-S524 (Standard for the Installation of Fire Alarm Systems)

.10 CAN/ULC-S537 (Standard for the Verification of Fire Alarm Systems)

1.4 DEFINITIONS

.1 EPO: Emergency Power Off.

1.5 ACTION SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Product Data: For each type of product indicated.

.3 Shop Drawings: Prepare in accordance with requirements of NFPA 13 and NFPA 2001, to include, but not be limited to, the following:

.1 Include plans, elevations, sections, and attachment details.

.2 Include design calculations.

.3 Include details of equipment assemblies. Indicate dimensions, weights, loads, manufacturer-required clearances, method of field assembly, components, and location and size of each field connection.

.4 Include diagrams for power, signal, and control wiring.

.5 Permit-Approved Documents: Working plans and hydraulic calculations approved by authorities having jurisdiction.

.6 Mounting and installation details of addressable modules, integrated pull station/abort switch, strobes, electronic horns, valves, piping, cylinders, etc.

.7 Battery capacity calculations

.8 Control equipment and agent releasing panel, physical arrangement and features, rack arrangement and interconnection wiring

.9 Installation manual

.10 Programming manual

.11 Complete parts list for system components

.12 Complete input/output listing and assignments of devices

.13 Complete manufacturer's technical data for devices and control panel components

.14 Applications manual

.15 product data sheets to indicate:

.1 performance criteria, compliance with appropriate reference standards, characteristics, limitations, and trouble-shooting protocol

.2 a complete description of the system operation

.3 product storage, handling and installation requirements

.4 System Design Calculations: Submit complete design and computerized verification of flow calculations with, as a minimum, the following data:

.1 quantity of agent per nozzle

.2 type of nozzle

.3 pressure at nozzle

.4 nozzle body nominal pipe size

.5 number and size of cylinders

.6 total agent

.7 pipe size per pipe section

.8 pipe schedule per pipe section

.9 number, size and type of fitting per pipe section

.10 actual length per pipe section

.11 equivalent length per pipe section

.12 discharge time

.13 calculated room volume with details of discounted elements

.14 design concentration

.15 design concentration safety factor

.16 Inspection Report: Submit an inspection and test report and certification by supplier confirming that the installation is in accordance with the Contract Documents and manufacturer's requirements.

.5 Retain a Licensed Professional Engineer, with experience in Work of comparable complexity and scope, to perform the following services as part of the Work of this Section:

.1 Design of clean agent fire suppression and pre-action system and sizing calculations.

.2 Review, stamp, and sign shop drawings and design calculations.

.3 Monitor and report on manufacturer's quality control tests and reports for compliance with Contract Documents.

.4 Certify system in accordance with requirements of NFPA 13 and NFPA 2001.

.6 Delegated-Design Submittal: For clean-agent fire-extinguishing and pre-action systems indicated to comply with performance and design criteria, including analysis data signed and sealed by the qualified Licensed Professional Engineer responsible for their preparation.

.7 Regulatory requirements:

.1 Prior to purchase and installation of sprinkler system, submit documents to authority having jurisdiction and obtain their approval.

.2 Make submissions to authority having jurisdiction well in advance so as not to delay installation.

1.6 INFORMATIONAL SUBMITTALS

.1 Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades. Coordinate for enclosure integrity in accordance with NFPA 13 and NFPA 2001 requirements.

.2 Qualification Data: For qualified Installer and a Licensed Professional Engineer

.3 Seismic Qualification Data:

.1 Post disaster facility, as applicable.

.2 Certificates for extinguishing-agent containers and control panels, from manufacturer.

.1 Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

.2 Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

.3 Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

.4 Welding certificates.

.5 Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: For clean-agent fire-extinguishing and pre-action system to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

.1 Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

.1 Detection Devices: Not less than 20 percent of amount of each type installed.

.2 Container Valves: Not less than 10 percent of amount of each size and type installed.

.3 Nozzles: Not less than 20 percent of amount of each type installed.

.4 Extinguishing Agent: Not less than 100 percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

1.9 QUALITY ASSURANCE

.1 Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.

2 Products

2.1 PERFORMANCE REQUIREMENTS

.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in CSA/ ULC, , and marked for intended location and application.

.2 ULc Compliance: Provide equipment listed in ULc's "Fire Protection Equipment Directory."

.3 Seismic Performance: See Section 20 05 50 – Seismic Restraint System, as applicable.

.4 Seismic Performance: Fire-suppression piping shall withstand the effects of earthquake motions determined in accordance with NFPA 13 and ASCE/SEI 7.

.1 The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.

2.2 SYSTEM DESCRIPTION

.1 Supply and install a self-contained FireFlex® DUAL, combining Pre-action system with clean agent system Engineered Novec™ 1230 type as indicated, including:

.1 Integrated cabinet

.2 Clean agent suppression system

.3 Pre-action Double Interlock

.4 Dual agent Releasing Control Panel

.5 The integrated unit shall include an FM Approved SEVO clean agent system in a cabinet enclosure.

.2 Extinguishing agent shall be Novec 1230, Dodecafluoro-2-methylpentan-3-one. Novec 1230 is a trade name for FK-5-1-12 fire extinguishing clean agent, manufactured by 3M

2.3 CLEAN-AGENT SYSTEMS

.1 Source Limitations: Obtain clean-agent systems from single source from single manufacturer.

.2 The Novec™ 1230 system shall be a 500psi Engineered type system. It shall have a minimum design of 4.2% volumetric concentration for Class A hazard and a minimum of 5.85% volumetric concentration for Class B hazard, minimum concentration for Class C hazard shall be at least that for Class A surface fire, at the minimum anticipated temperature with the protected area.

.3 System design shall not exceed 10% for normally occupied spaces, adjusted for maximum space temperature anticipated altitude and with provisions for room evacuation before agent release.

.4 System shall provide total flooding Novec 1230 concentration in maximum 10 seconds for a 10 minutes holding time.

2.4 PRE-ACTION SYSTEMS

.1 Source Limitations: Obtain clean-agent systems from single source from single manufacturer

.2 System design as per drawings occupancy hazard depicted requirements.

2.5 CLEAN AGENT CABINET

.1 Supply and install an integrated FireFlex® DUAL clean agent cabinet with Novec™ 1230 clean agent suppression system containing all hydraulic, pneumatic, fire extinguishing fluid and devices, and electrical components required for the control of an integrated clean agent system. A releasing control panel shall be integrated within the cabinet.

.2 System shall include the following:

.1 Self-contained unit in sturdy free-standing 14 gauge steel cabinet, measuring 23" x 25" x 77⅛" (58 x 64 x 196 cm),

.2 Textured rust proof coating, inside and outside, fire red, oven baked polyester powder on phosphate base (powder coated).

.3 One locked access door to reduce front area required for opening, easily removable without tools to allow easy installation & servicing. It shall also be provided with a neoprene gasket to avoid vibrations.

.3 Integrated clean agent system

.1 SEVO 1230 clean agent storage cylinder assembly steel pressure vessel c/w pressure supervisory switch, manufactured, tested and stamped in accordance with applicable DOT

and Transport Canada markings. The agent storage cylinder will be pressurized with 500 psi of nitrogen at the factory. Cylinders of 322 & 601 lbs capacity should also be provided with a liquid level indicator.

.2 3M™ Novec™ 1230 fire protection fluid (also known as FK-5-1-12). Agent shall not contain any hydro-fluorocarbons (HFCs).

.3 SEVO Discharge Valve Assembly shall be of brass construction and designed as per the pressure differential concept. It shall be complete with piston, seal, siphon tube, pressure gauge and releasing controls including electric actuator.

.4 A Pressure Supervisory Switch shall be provided on the SEVO cylinder to monitor the pressure within the cylinder should a loss of nitrogen occur. The low pressure switch is wired to a supervisory circuit to provide a Supervisory indication upon activation.

.4 Integrated Pre-action System

.1 Viking Deluge Valve model F-1, complete with releasing trim rated at 250 psi and all the necessary accessories. Trim shall include a mechanical latching device to prevent system from resetting in case of loss of power to the release solenoid. Systems provided with solenoid only, without this mechanical latching device, shall not be accepted. Every valve shall be clearly identified as to its operation with arrows indicating all positions to facilitate system operation.

.2 Pressure gauges to indicate water supply, priming water and air pressures of the system. Each pressure gauge must be provided with its own three-way valve and shall be clearly identified on the outside of the cabinet front door.

.3 Release trim with solenoid valve and every supervisory and alarm device required shall be Schedule 40 galvanized steel. Black pipe will not be accepted.

.4 Schedule 40 steel pipe header shall be painted fire red, with grooved ends to be connected to supply water from the left-hand side of the cabinet.

.5 Schedule 40 steel pipe drain manifold of 2" diameter shall be painted fire red, with grooved ends for drain connections from the left-hand side of the cabinet.

.6 Trim shall include properly identified contractor test ports factory mounted into the trim piping to facilitate system testing and commissioning.

.5 Integrated release control panel

.1 Potter PFC-4410RC dual agent integrated control panel with emergency batteries, factory-assembled within the FireFlex® DUAL enclosure.

.2 Field wiring terminal strips integrated with the cabinet for connection of field wiring.

.6 The clean agent cabinet assembly must be pre-assembled, pre-wired and factory tested under ISO-9001 conditions, as a FireFlex® DUAL System, by FireFlex Systems Inc.

.7 The system shall be complete in all ways.

.8 The system shall incorporate all components required for complete system operation

2.6 INTEGRATED CONTROL PANEL

.1 The release control panel must be fully integrated to the FireFlex® DUAL cabinet and installed in its own enclosure inside the cabinet, mounted at the factory.

.1 The control panel shall be FM Approved for clean agent release and in conformance to UL 864-9. Panel shall include four programmable Class B, Style B initiating zones, two class B supervisory zones, and four programmable output circuits. Onboard, menu-driven programming with pre-installed programs for ease of set-up must also be provided. The panel must be compatible with many different initiating devices including linear heat

detection, smoke and heat detectors, water flow indicators, low air pressure switches, and manual pull stations.

.2 The control panel should include both an LCD Annunciator describing all system conditions (16 characters on 2 lines) and a set of red & yellow LED lamps identifying each separate alarm and trouble conditions. Easy to operate control buttons shall also be included for the operation of the panel various functions.

.3 The control panel should be pre-wired at the factory to a set of industrial grade wiring terminals used for power feed. External wiring to field devices (outside the cabinet) should also be wired by the installing contractor to the set of wiring terminals provided.

.4 A set of emergency batteries should be provided with the control panel. Batteries should be calculated to provide emergency power for 90 hours after which they shall be able to provide 10 minutes of alarm and activation of the solenoid valve(s).

2.7 AUTOMATIC AND MANUAL DETECTION DEVICES

.1 Supply and install a complete electrical detection system including conduit, wiring, heat and/or smoke detectors, manual pull stations, abort stations, strobes, horns, warning labels and connections to auxiliary functions.

.2 Heat and/or smoke detectors should be wired on either Zones 1 or 2. Where more than the allowable quantity of detectors is required on a same detection zone, use the recommended 4-wire type detector base for that detector

.3 Manual pull stations shall be connected on Zone 4

.4 Provide Abort stations. Abort stations shall be “dead man” type and connected on Supervisory Zone 1

.5 All devices shall be cUL/ CSA certified and shall fully interface with the fire alarm systems.

2.8 NOTIFICATION DEVICES AND SIGNS

.1 Supply and install a complete notification system including Conduit, wiring, and notification devices.

.2 The NAC devices (24 Vdc bell, horn or strobe) must be compatible with the release control panel.

.3 Audible & visual pre-discharge alarms shall be provided within the protected area and to entrances into the area to give positive warning of impending discharge.

.4 All strobes shall be synchronized with the fire alarm strobes.

.5 Horns shall have a distinctive sound (differentiate from all other alarm and fire alarm horns)

.6 Additional signage and visual and audible notifications as per NFPA and CSA requirements.

2.9 CAUTION & ADVISORY SIGNS

.1 Warning and instruction signs at entrance to and inside protected areas shall be provided.

.2 A manual discharge sign is required at each manual release station and clearly indicate which hazard is controlled by the station.

.3 Additional signage and visual and audible notifications as per NFPA and CSA requirements.

2.10 SEQUENCES OF OPERATION

.1 System sequence of operation shall be pre-set at the factory and perform the following:

.1 Actuation of one (1) detector within the system:

.1 “COMMON ALARM” light flashes.

.2 “ZONE 1 or 2” light flashes.

.3 “DETECTION ZONE #1 or #2” message appears on the LCD.

.4 "1st alarm output" activates

.5 "ALARM" contact activates.

.2 Actuation of a 2nd detector within the system:

.1 "Pre-Discharge" light flashes.

.2 "ZONE 1 or 2" light flashes.

.3 "DETECTION ZONE #1 or #2" message appears on the LCD.

.4 "2nd alarm output" activates

.5 Pre-discharge delays starts. (Not to exceed 60 sec.)

.3 After completion of the Pre-discharge delay sequence:

.1 "Discharge" light illuminate steady.

.2 NOVEC 1230 electric actuator activates

.3 "ZONE 3" light flashes. (if discharge option selected)

.4 "WATERFLOW ZONE #3" message appears on the LCD. (if discharge option selected)

.5 "WATERFLOW" contact activates. (if discharge option selected)

.6 "OUTPUT #4 RELEASING" message appears on the LCD.

.7 Pre-action electric solenoid valve activates.

.8 "OUTPUT #3 RELEASING" message appears on the LCD.

.9 Pre-action will not be filled with water at this time.

.4 After a Pre-action sprinkler head fuses:

.1 Pre-action Valve opens, water will flow into the sprinkler piping and out of sprinklers and any opening on the system.

.2 "ZONE 3" light flashes. (if not activated at step C)

.3 "WATERFLOW ZONE #3" message appears on the LCD. (if not activated at step C)

.4 "WATERFLOW" contact activates. (if not activated at step C)

.2 Provide interface and interlock with the fire alarm and BAS systems.

2.11 CLEAN AGENT SYSTEM PIPING

.1 Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.

.2 Steel Pipe: ASTM A53/A53M, Type S, Grade B or ASTM A106/A106M, Grade A and Grade B; Schedule 40, Schedule 80, and Schedule 160, seamless steel pipe.

.1 Threaded Fittings:

.1 Malleable-Iron Fittings: ASME B16.3, Class 300.

.2 Flanges and Flanged Fittings: ASME B16.5, Class 300 unless Class 600 is indicated.

.3 Fittings Working Pressure: 4278 kPa (620-psig) minimum.

.4 Flanged Joints: Class 300 minimum.

.2 Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.

.3 Steel, Grooved-End Fittings: FM Approved and NRTL listed, ASTM A47/A47M malleable iron or ASTM A536 ductile iron, with dimensions matching steel pipe and ends factory grooved in accordance with AWWA C606.

.3 Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

.1 ASME B16.21, nonmetallic, flat, asbestos-free, 3.2-mm (1/8-inch) maximum thickness unless thickness or specific material is indicated.

.4 Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

.5 Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

.6 Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

2.12 PRE-ACTION SYSTEM PIPING

.1 System piping and fittings shall comply with NFPA 13 requirements.

2.13 PRE-ACTION AUTOMATIC SPRINKLERS

.1 Supply and install all required automatic sprinklers

.2 Sprinklers shall be glass bulb type, UL/ULC listed and FM approved and shall comply with NFPA 13 requirements.

2.14 VALVES

.1 General Valve Requirements:

.1 UL listed or FM Approved for use in fire-protection systems.

.2 Compatible with type of clean agent used.

.2 Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.

.3 Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.

.4 Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

2.15 EXTINGUISHING-AGENT CONTAINERS

.1 Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.

.1 Finish: Red, enamel or epoxy paint.

.2 Manifold: Fabricate with valves, pressure switches, and connections for multiple storage containers, as indicated.

.3 Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.

.4 Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.

2.16 DISCHARGE NOZZLES

.1 Nozzles shall be SEVO 1230 Engineered Nozzles. 360° (central) and 180° (sidewall) nozzles shall be installed as per the manufacturer's recommendation in the design manual.

2.17 AIR SUPPLY

.1 The automatic sprinkler piping is supervised by compressed air from a source installed inside the pre-action cabinet.

.2 The air compressor must be of the proper size in order to be able to restore normal system air pressure within 30 minutes.2.12 Sprinkler System Drain

.3 The single drain collector of the FireFlex DUAL System shall be connected to an open drain (open end pipe with an air gap around the drain pipe or equivalent).

.4 The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector. It shall also be arranged to avoid back-pressurizing the drain trim.

.5 Multiple drain collectors and open drain cups inside the cabinet will not be accepted.

.6 Open drain should be outside the protected area, if installed inside protected area, drain should have traps to avoid gas leakage on discharge.

.7 Manifolding of multiple units is permitted provided the manufacturer's recommendations are carefully followed and complied with.

2.18 DETECTION DEVICES

.1 Description: Comply with NFPA 2001, NFPA 72, and UL 268; 24 V dc, nominal.

.2 Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.

.3 Photoelectric Detectors: LED light source and silicon photodiode receiving element.

.4 Remote Air-Sampling Detector System: Includes air-sampling pipe network, laser-based photoelectric detector, sample transport fan, and control unit.

.1 Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.

.2 Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.

.3 Sample Transport Fan: Centrifugal type, creating a minimum static pressure of 12.5 Pa (0.05 inch wg) at all sampling ports.

.4 Control Unit: Multizone unit as indicated on Drawings. Provides same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.

.5 Signals to the Central Fire-Alarm Control Panel: Any type of local system trouble is reported to central fire-alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to central fire-alarm control panel as separately identified zones.

2.19 MANUAL STATIONS

.1 Description: Surface FM Approved or NRTL listed, with clear plastic hinged cover, 120-V ac or low-voltage compatible with controls. Include contacts for connection to control panel.

.2 Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.

.3 Abort Switch: "ABORT" caption, momentary contact, with green finish.

2.20 SWITCHES

.1 Description: FM Approved or NRTL listed, where available, 120-V ac or low-voltage compatible with controls. Include contacts for connection to control panel.

.1 Low-Agent Pressure Switches: Pneumatic operation.

.2 Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.

.3 Door Closers: Magnetic retaining and release device or electrical interlock to cause door operator to drive the door closed.

2.21 ALARM DEVICES

.1 Description: FM Approved or NRTL listed, low voltage, and surface mounting. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" or Section 284621.13 "Conventional Fire-Alarm Systems" for alarm and monitoring devices.

.2 Bells: CSA approved, Minimum 150-mm (6-inch) diameter.

.3 Horns: CSA approved, 90 to 94 dBA.

.4 Strobe Lights: CSA approved, Translucent lens, with "FIRE" or similar caption.

.5 Oxygen Deficiency Monitor.

.1 Sampling Method and Range: Diffusion, zero to 25 percent O2.

.2 24 V dc.

.3 Wall mounted with bracket.

.4 Built-in audible alarm 90 dBA.

.5 Backlit LCD.

.6 10-year no-calibration sensor.

.7 No maintenance required.

.8 Signal Outputs: Standard 4- to 20-mA analog.

.9 Connections for system control data acquisition system and/or programmable logic controller.

.10 Plus or minus 1 percent accuracy of full scale.

.11 Operating temperature of minus 40 to plus 50 deg C (minus 40 to plus 122 deg F).

2.22 INTERLOCKS AND INTERFACE

.1 Supply and install interlock replays, wiring & conduit for shutdown of HVAC equipment, air dampers, etc., electrical power supplies, or shunt trip breaker.

.2 Provide fire alarm interface. Refer to fire alarm for further requirements.

.3 Provide BAS interface. Refer to control drawings and BAS specifications for further requirements.

3 Execution

3.1 EXAMINATION

.1 Examine areas and conditions, with Installer present, for compliance with enclosure integrity requirements, installation tolerances, and other conditions affecting performance of the Work in accordance with NFPA 2001.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

.3 The installation must meet National & Local standards and be done according to all applicable laws, regulations and codes.

.4 The proper operation and coordination for the system's installation, including the clean agent system, detection system, signaling system and initial start-up are all under the responsibility of the fire protection contractor.

3.2 CLEAN-AGENT SYSTEM INSTALLATION

.1 Install clean-agent containers, piping, and other components level and plumb, in accordance with manufacturers' written instructions.

.2 Clean-Agent Container Mounting:

.1 Install clean-agent containers on cast-in-place concrete equipment bases.

.3 Comply with requirements for vibration isolation and seismic-control devices specified in Section 200550 – Seismic Restraint System.

.4 Comply with requirements for vibration isolation devices specified in Section 20 05 48 – Vibration Isolation.

.5 Install pipe and fittings, valves, and discharge nozzles in accordance with requirements listed in NFPA 2001, Section "Distribution."

.1 Install valves designed to prevent entrapment of liquid, or install pressure relief devices in valved sections of piping systems.

.2 Support piping using supports and methods in accordance with NFPA 13.

.3 Install seismic restraints for extinguishing-agent piping systems.

.4 Install control panels, detection system components, alarms, and accessories, in accordance with requirements listed in NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.

3.3 PIPING CONNECTIONS

.1 Drawings indicate general arrangement of piping, fittings, and specialties.

.2 Where installing piping adjacent to equipment, allow space for service and maintenance.

3.4 ELECTRICAL CONNECTIONS

.1 Connect wiring in accordance with Division 26.

.2 Ground equipment in accordance with Division 26.

.3 Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with CSA and Electrical Code.

.4 Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

.5 Connect electrical devices to control panel and to building's fire-alarm system. Electrical power, wiring, and devices are specified in Division 26 and 28.

3.5 CONTROL CONNECTIONS

.1 Install control and electrical power wiring to field-mounted control devices.

.2 Connect control wiring in accordance with Division 26.

3.6 IDENTIFICATION

.1 Identify system components and equipment.

.2 Identify piping, extinguishing-agent containers, other equipment, and panels in accordance with NFPA 13, 2001 CSA and or other labeling and painting contractual requirements.

.3 Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire-extinguishing system.

.4 Install signs at entry doors to advise persons outside the room the meaning of horn(s), bell(s), and strobe light(s) outside the protected space.

3.7 FIELD QUALITY CONTROL

.1 Testing Agency: Engage a qualified testing agency to perform tests and inspections.

.2 Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

.3 Perform tests and inspections with the assistance of a factory-authorized service representative.

.4 Tests and Inspections:

.1 After installing clean-agent fire-extinguishing system and after electrical circuitry has been energized, test for compliance in accordance with requirements listed in NFPA 2001, Section "Approval of Installation."

.2 Clean-agent fire-extinguishing system and associated protected enclosure will be considered defective if either does not pass required tests and inspections.

.3 Prepare test and inspection reports in accordance with requirements listed in NFPA 2001, Section "Installation Acceptance."

3.8 CLEANING

.1 Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.

3.9 OPERATIONAL CONDITION SYSTEM FILLING

.1 Preparation:

.1 Verify that clean-agent fire-extinguishing system and protected enclosure have passed all required tests and inspections in accordance with NFPA 2001.

.2 Verify that clean-agent fire-extinguishing piping system installation is completed and cleaned.

.3 Verify complete enclosure integrity.

.4 Verify operation of ventilation and exhaust systems.

.2 Filling Procedures:

.1 Fill clean-agent fire-extinguishing containers with extinguishing agent, and pressurize to indicated charging pressure.

.2 Install filled containers.

.3 Energize circuits.

.4 Adjust operating controls.

3.10 TRAINING

.1 The fire protection contractor must plan and organize a training session of at least four hours for the building maintenance staff, in the presence of the City or his representative.

.2 The training session must include the normal operation, emergency procedures and maintenance of the system.

3.11 TESTING AND VERIFICATION

.1 The verification of the fire alarm system must be done in accordance with Division 26.

.2 The verification of the clean agent must be done in accordance with NFPA 2001 requirements.

.3 The verification of the pre-action must be done in accordance with NFPA 13 requirements.

.4 The Contractor shall be responsible for sealing and securing the protected spaces against agent loss and/or leakage during the 10-minutes “hold” period.

.5 The clean agent system piping shall be pneumatically tested in a close circuit for a period of 10 minutes at 40 psi (2.8 bars). At the end of the 10 minutes, the pressure drop shall not exceed 20% of the test pressure. The pressure test can be omitted in the case where the total piping contains no more than one change in direction fitting between the storage cylinder and the discharge nozzle, and where all piping is physically checked for tightness.

.6 A room pressurization test shall be conducted by the installing contractor in each protected space to determine the presence of openings which would affect the agent concentration levels. All testing shall be made in accordance with NFPA 2001, Annex C.

.7 If the room pressurization testing indicates that openings exist which would result in leaks and/or loss of the extinguishing agent, the installing contractor shall be responsible for coordinating the proper sealing of the protected space(s) by the Contractor, sub-contractor or agent. The installing contractor shall inspect all work to ascertain that the protected space(s) have been adequately and properly sealed.

.8 Hydrostatic tests must be performed on the entire sprinkler piping system, as required by NFPA 13.

.9 In addition to the standard hydrostatic test, an air pressure leakage test at 40 psi (2.8 bars) shall be conducted for 24 hours. Any leakage that results in a loss of pressure in excess of 1½ psi (0.1 bar) during the 24 hours shall be corrected.

.10 A drain test using the auxiliary drain valve fully open (drain located on water supply side, deluge valve inlet) must be performed to verify that the water supply is adequate and to make sure that no back pressure in drain piping exists, which could affect the proper operation of the preaction system.

.11 An air supply test must be performed, to confirm that normal air pressure in the sprinkler system can be restored within 30 minutes.

3.12 CHEMICAL RESISTANT CORROSION COATING

.1 All exposed piping and equipment installed in the areas subject to water spray, humid and or corrosive environment locations shall be treated, painted and coated with chemical resistant base and top coatings in accordance with the Sections 099000 and 099656.

3.13 DEMONSTRATION

.1 Engage a factory-authorized service representative to train City's maintenance personnel to adjust, operate, and maintain clean-agent fire-extinguishing systems.

3.14 REPORT AND CERTIFICATE

.1 An inspection report and a certificate must be supplied by the fire protection contractor to the Contract Administrator, City or City’s representative at the completion of the project. All tests results shall be duly registered in a booklet to be included with the inspection report.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements

.2 Section 20 05 50 – Seismic Restraints

.3 Section 21 11 19 – Fire Department Connections

.4 Section 22 13 16 – Drainage Waste and Vent Piping

.5 Section 21 05 23 – General-Duty Valves for Water-Based Fire-Suppression Piping

.6 Division 26 – Electrical power wiring connections to equipment

.7 Division 26 – Fire alarm system wiring connections to equipment

1.2 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings: Submit fire protection system shop drawings to the regulatory authority for review and approval prior to submitting to the Contract Administrator. Conform to the following requirements:

.1 submit shop drawings for all products specified in this Section except pipe and fittings

.2 submit complete fire protection systems layout drawings indicating source of water supply, "head end" equipment piping schematic, pipe routing and sizing, and zones, all signed and sealed by a qualified Licensed Professional Engineer.

.3 submit copies of all calculations signed by the same engineer who signs the layout drawings, and a listing of all design data used in preparing the calculations, system layout and sizing

.4 in addition to submitting shop drawings to the regulatory authority as specified above, shop drawings must be approved by the City's insurer prior to being submitted to the Contract Administrator for review

.5 Product data including certified performance curves and related capacities of selected models, weights, furnished specialties and accessories. Indicate pumps operating point on curve.

.6 Submittal package shall include at a minimum

.1 Mechanical general arrangement drawing of complete fire pump package and accessories

.2 Project specific electrical schematics for all system wiring including controllers

.3 Manufacturers' equipment submittal datasheets for all controllers, fuel tank, valves, and specialties.

.4 Process and Instrumentation Diagram for complete assembled system

.7 Test Data: Submit the following test data prior to application for substantial performance:

.1 pipe leakage test sheets

.2 a copy of a certification letter from the fire pump set supplier as per Part 3 of this Section

.8 Certificates: Submit certificates and documentation specified in this Section.

.3 Regulatory requirements:

.1 Prior to purchase and installation of fire pump system, submit documents to authority having jurisdiction and obtain their approval.

.2 Make submissions to authority having jurisdiction well in advance so as not to delay installation.

1.3 REFERENCES

.1 The latest issue (at time of Tender) of the following Codes and Standards govern the design and installation of the fire protection work:

.1 NFPA 13 - Installation of Sprinkler Systems

.2 NFPA 14 - Installation of Standpipe and Hose Systems

.3 NFPA 20 - Standard for the Installation of Centrifugal Fire Pumps

.4 National Building Code

.5 National Fire Code

.6 Institute of Electrical and Electronic Engineers (IEEE)

.7 National Electrical Manufacturers Association (NEMA)

.8 American Society for Testing and Materials (ASTM)

.9 National Electric Code (NEC)

.10 Occupational Safety and Health Administration (OSHA)

.11 ANSI/HI standards

.12 Underwriters Laboratories, Inc.

.13 Underwriters Laboratories of Canada

1.4 DESIGN REQUIREMENTS

.1 This section includes provision of a complete jockey/ fire pump package, delivery, installation, startup and commissioning of skid mounted diesel engine-driven fire pump system, including but not limited to, fire pump with drive and associated controller, electric driven jockey pump each with drive and associated controller with interconnecting piping and wiring.

.2 Comply with NFPA 20 requirements

.3 System shall bear the ETL label for packaged fire pump systems based on NFPA 20.

.4 All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified or denoted on the drawings.

.5 The skid mounted fire pump shall be assembled by the pump manufacturer. An assembler of fire pump skids not engaged in the design and construction of fire pumps shall not be considered as a fire pump manufacturer. The manufacturer shall assume “Single Source Responsibility” for the complete fire pump system.

.6 Fire pump system components assembled and affixed onto a structural steel framing assembly as designed under direction of a qualified Professional Engineer, fabricated by welders qualified in accordance with ASME BPVC code section IX and AWS section D1.1, and assembled at a Listed and Approved Manufacturing facility. After completion, the Assembly is shipped as a unit to the installation site. The Packaged Fire Pump Assembly may be assembled onto the structural steel framing assembly either with or without an environmental enclosure constructed from non-flammable materials.

.7 Test fire pumps at the factory to ensure the performance as specified and as required by NFPA 20. Copies of certified factory test data shall be available for comparison during field acceptance tests.

System shall be hydrostatically tested as a complete unit at the factory after fabrication and before shipping. All test results shall be recorded and sent to the buyer for their records.

.8 Test all electrical components for proper installation, connection and operability.

.9 Furnish all material that is new and unused and free from defects in workmanship and material.

.10 Manufactures Qualifications:

.1 Pump manufacturer and system assembler shall be the same

.2 Minimum of 25 years' experience in production and assembly of fire pumps and fire pump systems.

.11 Provide services of qualified manufactures representative to assist in the installation, complete checkout and startup of equipment and commissioning.

.12 Manufacturer or supplier shall have the capability to provide repair, maintenance and parts supply service for all furnished components.

.13 Do not commence fabrication and assembly of packaged system until review of all submittal data by City's Representatives is completed and written release to production is received.

.14 Engineer and City's Representative shall be able to inspect construction of packaged pump system at the manufactures facility with 72 hour notice.

.15 Seismic Criteria for post disaster facility. All equipment and piping shall be provided with seismic restraints. Where conflicting requirements occur between other codes or standards, the more stringent requirements shall apply.

.16 Fire protection work is to be designed by an accredited fire protection company.

.17 Fire protection system work is to be designed in accordance with NFPA and Provincial Codes, and where required, local building and fire department requirements and the standards of the City's Insurer.

.18 Provide all additional working drawings and /or load calculations required and submit with shop drawings.

.19 Water Supply: Conduct Municipal main water flow and pressure tests at the nearest fire hydrant to obtain criteria to be used in fire protection system design. Include hydrant location and flow and pressure test data with system design calculations.

.20 Maximum incoming water pressure: 48.3 kPa (7 psi) less than available water supply pressure at required flow rate, to account for future fluctuation in water supply pressure.

.21 System zoning as indicated in contract drawing.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Protect all equipment, connection surfaces, piping, wiring, fluid passages and working parts from damage during shipment, handling and storage.

.2 The packaged pumping system shall be factory assembled and shipped as a complete unit, shipment in sections might be required due to restrictions or equipment limitations.

.3 Store material in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.

.4 Repair or replace all items damaged during shipment and delivery.

1.6 QUALITY ASSURANCE

.1 All site personnel are to be under the continuous supervision of a foreman who is an experienced fire protection system installer and a journeyman pipefitter.

.2 Check and verify all dimensions and conditions at the site and ensure that the Work can be performed as indicated.

.3 Co-ordinate fire protection Work with all trades at the site and accept responsibility for and the cost of making adjustments to piping and or spacing to avoid interference with other building components.

.4 All system components must be ULC listed and labelled.

.5 The fire pump shall be assembled by the pump manufacturer. An assembler of fire pumps not engaged in the design and construction of fire pumps shall not be considered as a fire pump manufacturer. The manufacturer shall assume “Unit Responsibility” for the complete fire pump. Unit responsibility shall be defined as responsibility for interface and successful operation of all system components supplied by the pumping system manufacturer.

.6 Equipment provider shall be responsible for providing certified equipment start-up. This pump start-up shall be by the pump manufacturer or a certified factory-trained representative per NFPA 20, Section 11-2. This start-up shall include verification of proper installation, system initiation, adjustment and fine tuning. Start-up shall not be considered complete until the sequence of operation, including all alarms, has been sufficiently demonstrated to the City or City’s designated representative. This job site visit shall occur only after all hook-ups, tie-ins, and terminations have been completed and signed off on the manufacturer’s start-up request form.

2 Products

2.1 PIPE, FITTINGS AND JOINTS

.1 PVC: Ipex "Brute Brute " Class 200, DR14, rigid, hub and spigot pattern PVC pipe and CSA certified fittings to CSA B137.2 and B137.3, ULC listed and FM approved and complete with gasketed joints.

.2 Schedule 40 Steel - Gooved Coupling Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with mill or site roll grooved ends, and Victaulic "Fire Lock" or "FIT Style 960 fittings", Gruvlock Fig. #7105 "Sock-It" fittings, Tyco Fire Suppression & Building Products Mechanical Outlet Tee Fig. 730 and Victaulic Style 005, Tyco Fire Suppression & Building Products #772, Gruvlok Rigid-Lite #7400, Shurjoint "Speed" or "Z05" rigid coupling joints or approved equivalent. Snap-Let type or strap type fittings are not acceptable.

.3 Schedule 40 Steel - Screwed and Welded Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B. Screwed piping is to be complete with Class 125 cast iron screwed fittings to ANSI/ASME B16.4. Welded piping is to be complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, long sweep pattern wherever possible.

.4 Pipe paint: Base paint to be glass-filled epoxy, 0.58 VOC , anti-slip, corrosion resistant, chemical resistant, non-slip, suitable for coastal environments. Colour: red.

2.2 SHUT-OFF VALVES

.1 Minimum 1205 kPa (175 psi) rated ULC listed and FM approved lug body or grooved end type ball or butterfly valves. Acceptable products are:

.1 National Fire Equipment/GEC Alsthom butterfly type

.2 Victaulic Series 728 "FireLock" ball type (Victaulic Series 705W FireLock is not acceptable)

.3 Tyco Fire Suppression & Building Products model BFV-N

.4 Tyco Fire Suppression & Building Products Butterfly valve "Butterball" Model BB-SCS01

.5 Anvil Series 8000FP

.6 Nibco Fig #3510-8, Fig #GD-4765

.7 Gruvlok Fig. AE7722-3A

.8 Global Safety Products Model BV

.9 Kennedy Valve Co. #01G

.10 Shurjoint #SJ-700W

2.3 CHECK VALVES

.1 Minimum 1205 kPa (175 psi) rated, resilient seat, ULC listed and FM approved check valves. Acceptable products are:

.1 Victaulic "VIC-CHECK" Series 717/716

.2 Tyco Fire Suppression & Building Products Model CV-1F

.3 Tyco Fire Suppression & Building Products Model CV-1FR Riser Check Valve

.4 Nibco #F-908-W, G-917-W, KW-900-W, KT-403-W or T-480

.5 Kennedy Valve Co. #426

.6 Shurjoint #RCV

.2 Check valves associated with siamese connection(s) and fire pump test connection are to be tapped for site installation of a 20 mm (¾") diameter ball drip.

2.4 BALL DRIPS

.1 National Fire Equipment Ltd. Model #58-2, Nibco Model #RG 22100, Tyco Fire Suppression & Building Products Model F789, 20 mm diameter automatic ball drip or approved equivalent.

2.5 SHUT-OFF VALVE SUPERVISORY SWITCHES

.1 ULC listed and FM approved, tamper-proof, 24 volt or 115 volt AC supervisory switches, each arranged to activate a fire alarm trouble alarm condition if the valve is closed or tampered with, and with each complete with all required mounting and connection hardware. Acceptable products are:

.1 Potter Electric Signal and Manufacturing Ltd. Model "OSYSU" or "PCVS"

.2 System Sensor #P1BV2 or OSY2

.3 Victaulic Style 737

2.6 FIRE PUMP PACKAGE

.1 ULC listed and labelled, FM approved pump set as per the Drawing schedule, factory assembled, prepiped and prewired on a common primed and enameled structural steel base, constructed and factory tested to NFPA 20 Standards, complete with a controller assembly, jockey pump, and jockey pump controller, and supplied ready for site piping and electrical connections.

.2 **Pump Set Operation:** Should pressure drop in the system, the jockey pump will start automatically and pressurize the system to a set pressure and then stop. If pressure in the system continues to decrease beyond the range of the jockey pump, the fire pump will start automatically and the jockey pump will shut-off. The fire pump will continue to operate until shut down manually.

.3 Fire pump:

.1 Provide a fire pump system (duty) designed in accordance with the requirements of NFPA #20 – latest edition. The fire pump shall be ULC listed for fire pump service at the specified rating

.2 The fire pump shall be single stage, split case, base mounted pump for fire suppression. Pump shall be designed to operate at 1750 rpm and deliver a rated capacity of 1500 USGPM at a rated differential pressure of 110 PSIG boost. The pump shall be rated for a maximum discharge pressure of 200 PSIG and a maximum hydrostatic pressure 338 PSIG. The pump discharge flange shall be 125# ANSI and the suction flange shall be 125# ANSI.

.3 Fire pump shall be driven by a maximum of 150 HP, 1750 RPM, 3 phase, 60 Hz, 575V, open drip proof motor with a 1.15 service factor. The motor shall be ULC listed and shall comply with the provisions of NFPA 70, National Electric Code as described in NFPA 20.

.4 At 150 percent of rated capacity, the pump shall develop at least 65 percent of its rated head and shall not exceed 140 percent of the rated head at zero capacity. The pump shall be tested at the factory and a test curve shall be submitted showing the performance and horsepower requirements based on this test before final acceptance.

.5 The pump shall be of cast iron, bronze fitted construction. The pump internals shall be capable of being serviced without disturbing piping connections.

.6 The pump casing shall be made of ductile iron ASTM A48, Class 35, with the suction and discharge flanges located on a common centerline, 180 degrees apart, for mounting in the pipeline.

.7 The impeller will be of a cast bronze ASTM B584up – Alloy 875, enclosed type, balanced, keyed to the shaft and secured by a cap screw and lock washer.

.8 The casing wear rings shall be made of bronze and can be easily replaced.

.9 The pump shall be direct coupled to the motor shaft for easy maintenance, to minimize impeller run out and reduce noise.

.10 The pump shall have split bronze packing glands for easy packing replacement.

.11 The stuffing box shall be furnished with impregnated yarn packing, lantern ring and a catch basin for piping leakage to drain

.12 The pump shall have a vertical back pullout design that makes servicing simple and fast. The rotating element is easily removed without disturbing the piping.

.13 A rubber slinger will be installed on the shaft before the motor to prevent the passage of liquid to the motor.

.14 Fire pump fittings shall include ¾" casing relief valves and 90mm (3½") suction and discharge gauges (dial type), and ¾" automatic air release valves.

.15 The fire pump and controller shall be shipped loose for installation. The contractor shall provide supervised ULC listed and OS&Y suction gate valve, ULC listed discharge water check valve, ULC listed discharge butterfly valve, 90mm (3½") butt welded venturi flow meter and spool piece to accommodate the casing relief valve, jockey pump, jockey pump piping, valves and pressure gauge, jockey pump controller, pressure sensing lines and hose-header tee. Wiring between the controllers and electric motors shall be done in the field.

.4 Jockey Pump:

.1 Provide a vertical multi-stage, close coupled, electrically driven jockey pump provided with accessories as required by NFPA 20.

.2 The pump shall have a capacity of 15 gpm at a differential pressure of 120 PSI. The pump shall be driven by a 2 HP, 575 volt, 3 phase, 60 Hz TEPE motor. The pump shall be of stainless-steel construction with Tungsten Carbide shaft sleeves and ceramic bearings. Shaft height shall be set with a standard spacer and shall have an internal mechanical seal with stationary carbon and rotating silicon carbide with Viton elastomers.

.3 The jockey pump controller shall be an automatic jockey pump controller suitable for use with the specified jockey pump. The jockey pump controller shall be of the combined manual and automatic type across-the-line starter. The controller shall be mounted in a NEMA/CSA 2. The controller shall have a full voltage starter and LED indicator lights.

.5 Electric fire pump controller:

.1 The fire pump manufacturer shall furnish a fire pump controller in duty arrangement. Pump shall have its own controller & automatic transfer switch mounted in a separate cabinet. The cabinets shall be assembled into a single unit and installed on a skid by the contractor. All interlocking wiring shall be factory installed and tested. The controller shall be provided with single point power connections for normal and alternate power. The fire pump controller shall be ULC listed.

.2 The full-service fire pump controller shall be ULC listed for fire pump service and certified by CSA. It shall carry ULC and CSA labels and meet the requirements of NFPA-20 as presently implemented by ULC. The controller shall be complete with a combined manual and automatic type, autotransformer reduced voltage starter and automatic transfer switch, wired and tested by the manufacturer. The starter shall be rated at 575 volts, 60 HP, 3 phase, 60 Hz. The full-service pump controller shall be mounted in a NEMA/UL/CSA 2.

.3 The automatic transfer switch and the fire pump controller shall each be mounted in a separate standard rated enclosure, mechanically attached to form one unit and provide for protected interlock wiring. The automatic transfer switch shall be capable of automatic power transfer from normal to generator set emergency power source in case of failure of normal supply and automatically re-transfer after restoration of normal power conditions.

.4 Fire pump controllers shall have a short circuit interrupting capacity of not less than 50kA.

.5 Pump control function:

.1 Controllers shall be assembled into a single unit with automatic transfer switch, with controller and transfer switch being housing in a separate enclosure. It allow for single point power connection for normal power source and single point power connection for alternate power source.

.6 The fire pump controller shall meet the requirements of NFPA 20 and shall incorporate the following components:

.1 An externally operable isolating switch, mechanically interlocked with the circuit breaker and door.

.2 Deluge valves start and weekly exercise.

.3 An externally operable circuit breaker, mechanically interlocked isolating switch providing short circuit magnetic trip and time delayed locked rotor trip.

.4 Voltage surge arrester

.5 Motor starting contactor rated to suit the pump motor and capable of being energized automatically by the pressure switch or manually by the start push button. The contacts of the motor starting contactor shall also be capable of being closed manually by an externally operable emergency start handle.

.6 Remote alarm contacts for phase reversal, motor run, phase loss.

.7 Individual dry alarm contacts for the following:

.1 Power failure or circuit breaker in the off position and/or loss of one phase.

.2 Phase reversal.

.3 Pump motor running.

.8 HMI display shall indicate power available and circuit breaker in the “ON” position, pump run, weekly test, and phase reversal pilot light.

.9 Start and stop manual push buttons.

.10 Provision for remote push button start.

.11 The automatic transfer switch shall be mechanically held and electrically operable. It shall provide automatic power transfer from normal to alternate power in case of a voltage drop below 90% of normal, phase failure, or phase reversal and automatic retransfer of power after restoration of normal power conditions. The automatic transfer switch shall furnish the following manual controls:

.1 An externally operable main isolating switch ahead of the alternate power terminals of the transfer switch.

.2 An operating handle to allow for the manual operation of the transfer switch.

.3 A test switch to momentarily simulate normal source failure.

.12 The automatic transfer switch shall furnish the following audio/visual alarms:

.1 Signal light (HMI display) to indicate the transfer switch is connected to the normal source.

.2 Signal light (HMI display) to indicate the transfer switch is connect to the alternate source.

.3 Signal light (HMI display) and audible alarm to indicate alternate power isolating switch.

.13 The automatic transfer switch shall furnish the following remote contacts:

.1 One normally closed contact for transfer switch connected to the normal source.

.2 One normally closed contact for transfer switch connected to the alternate source.

.3 One normally open and one normally closed contact for transfer switch isolating switch in the "OFF" position.

.4 One normally closed contact to start alternate source generator in case of normal power failure. Signal shall be interrupted if the isolation switch is in the "OFF" position.

.14 The automatic transfer switch shall furnish the following time delays:

.1 One delay factory set to 3 seconds to delay power transfer and generator start signals.

.2 One unloaded generator delay factory set to 5 minutes to allow generator cool down.

.3 One retransfer to normal power, delay factory set to 5 minutes with automatic bypass should the emergency power source fail.

.4 One electric motor start delay factory set to 2 seconds after power transfer to prevent current surges due to power source transfer.

.6 **Minimum Fittings:** the pump shall be supplied with the following, but not limited to, accessories:

.1 Fire pump fittings shall include at a minimum the following: an automatic air release valve, compound suction and discharge gauges (minimum 3.5 inch dials) supplied and sized per NFPA 20.

.2 Valves shall be UL/ULC listed and FM approved, with 175-psig minimum pressure rating. Valves shall have appropriate pressure rating if intended for use in a high pressure system.

.3 Where the suction pipe and pump suction flange are not of the same size they shall be connected by an eccentric tapered reducer or increaser installed in such a way as to prevent air pockets.

.4 A listed OS&Y gate valve with tamper switch shall be installed in the suction piping. The OS&Y valve shall be rated for the maximum working water pressure of the system. Valve

shall be manufactured out of ASTM A126 class B cast iron and have flanged ends. Valve shall have outside stem & yoke, full flow port, replaceable disc.

.5 A listed check valve shall be installed in the discharge piping. Valve shall comply with UL 312 unless noted. Check valve shall be grooved or flanged construction, single or double disc swing type listed for use in fire protection systems.

.6 A listed indicating butterfly valve shall be installed on the fire protection side of the pump discharge check valve. The butterfly valve shall be grooved body style and comply with UL 1090 with integral indicating device. Gear operator shall be indoor/outdoor rated and ends shall match connecting piping with molded in seat. Normally Open and Normally Closed tamper switch connections shall be provided for monitoring.

.7 All drains shall be piped to a common point for connection to a buyer supplied floor drain per NFPA 20.

.7 **Fire Pump** accessories:

.1 Hose Valve Header: System shall be equipped with hose valve header and valves. The hose valve header shall be sized per NFPA 20 2016 edition Table 4.26(a). Hose valve header shall be manufactured from cast iron or fabricated from ASTM A105 or ASTM A53 standard weight pipe. The test header shall be equipped with listed valves the number and size of hose valves for testing shall be as specified in Table 4.26(a). Hose valves shall be listed, 2-1/2" National Standard Thread, equipped with caps and chains unless otherwise specified. The hose valve header shall be equipped with and listed isolation valve and a minimum ¾" drain piped to a common point.

.2 Main Relief Valve: Where a total of 121 percent of net rated shutoff (churn) pressure plus the maximum static suction pressure, adjusted for elevation, exceeds the pressure for which the system components are rated a pressure relief valve shall be installed. The pressure relief valve shall be located between the pump and the pump discharge check valve and be so installed so it can be readily removed for repairs without disturbing the piping. The pressure relief valve shall be a spring loaded or pilot-operated diaphragm type. The relief valve shall discharge into and open pipe or into a cone or funnel secured to the outlet of the valve. If a closed type cone is used, it shall be provided with means for detecting motion of water through the cone. The pressure relief valve shall be UL Listed and FM Approved

.3 Flow meter loop: System shall be equipped with a flow meter loop sized in accordance with NFPA 20 2016 edition Table 4.26(a). The metering device shall be of the venturi type with grooved connections and installed per manufactures directions. The flow meter loop shall be complete with meter control and meter throttle valves. Valves shall be of the UL listed, FM approved indicating butterfly type.

.4 City Water Bypass: The system shall be equipped with a city water bypass arrangement sized in accordance with NFPA 20 2016 edition table 4.26(a). The bypass shall be supplied with two isolation valves and one check valve. Isolation valves shall be UL listed, FM approved indicating butterfly valves. Check valve shall be grooved or flanged construction, single or double disc swing type listed for use in fire protection systems

.8 Testing And Mounting:

.1 Fire pump will be hydrostatically tested to a pressure recommended by UL, ULC or FM. The fire pump shall be subjected to a performance test at rated speed. The pump shall furnish not less than 150% of rated capacity at a pressure not less than 65% of rated head. The shut-off head shall not exceed 140% of rated head. A certified test curve shall be supplied with the pump.

.2 The fire pump will be factory performance tested in accordance with the requirements of NFPA, UL and FM. The fire pump and jockey pump controllers will be electrically tested prior to shipment. Additionally, the entire package system will be hydrostatically tested at

the factory at a pressure rating per NFPA 20 Section 11-1.1 for a minimum of 2 hours. A copy of the test procedures shall be provided upon request.

2.7 FIRE PUMP TEST CONNECTION ASSEMBLY

.1 Potter-Roemer Inc. Fig. No. 686 Series flush wall mounting fire pump test connection assembly in accordance with NFPA 20 or approved equivalent, sized and arranged to suit the capacity of the fire pump and complete with:

.1 a cast brass header body with inlet located to suit site conditions, and 75 mm (3") dia. threaded outlet connections

.2 a 75 mm (3") dia. threaded pipe nipple for each outlet, with the length of the nipples to suit wall construction

.3 a polished brass NRS hose gate valve for each outlet, each valve complete with loose bonnet, 75 mm (3") female NPT inlet, 65 mm (2 ½") male hose thread outlet with screw-on cap and chain

.4 a polished faceplate with "PUMP TEST CONNECTION" cast in raised lettering.

.5 All exposed parts of the assembly are to be chrome plated.

3 Execution

3.1 SYSTEM PIPING INSTALLATION REQUIREMENTS

.1 Perform all required piping system Work.

.2 Do all piping work in accordance with requirements of NFPA 20.

3.2 INSTALLATION OF SHUT-OFF VALVES AND CHECK VALVES

.1 Provide shut-off valves and check valves in piping where shown.

.2 Locate all valves for easy operation and maintenance.

.3 Confirm exact locations prior to roughing-in.

3.3 INSTALLATION OF SHUT-OFF VALVE SUPERVISORY SWITCHES

.1 Unless otherwise specified, equip each shut-off valve with a supervisory switch.

.2 Identify each supervised valve with a 150 mm (6") square engraved laminated red-white plastic tag to correspond with supervised valve numbering specified and/or shown as part of the electrical work fire alarm system.

3.4 INSTALLATION OF FIRE PUMP SET

.1 Provide a fire pump set where shown. Secure the assembly in place, level and plumb, on a concrete housekeeping pad.

.2 Install piping from the pump set outwards with as few elbows as possible, and with long sweep pattern elbows where elbows are required. Arrange all piping so as not to restrict access to the power and control panels, and so as not to impede walking access in the room.

.3 Support piping connecting the pump set so that strain or pressure is not exerted on the pump.

.4 Pipe the pump casing relief valve to drain. Set the relief valve in accordance with the pump set supplier's instructions to suit site pressure conditions.

.5 Ensure that supervisory switches are provided on handles of pump set shut-off valves, where required.

.6 Adjust fire pump and jockey pump pressure switches in accordance with the pump set supplier's instructions to suit the site water pressure conditions.

.7 Start-up: When installation is complete but prior to application for substantial performance, review the installation on site with the pump set supplier, and under the supervision of the pump set supplier, start the pump set, (including requirements of part II- I of NFPA No. 20), check and adjust as required, and have the pump set supplier certify in writing that the pump set has been properly installed, started, checked and adjusted, and is ready for performance and acceptance testing. Submit a copy of the pump set supplier's certification.

.8 Pump Acceptance Testing: After pump set start-up has been performed and certified as specified above, perform field acceptance tests in accordance with part II-2 of NFPA 20. Testing is to be performed in the presence of the City, local Fire Chief, and the Contract Administrator, and testing is to include any additional tests required by the Fire Chief. Supply all required testing equipment. Document all tests performed, the results of the tests, and the names of those present during tests, and prepare and submit a complete test report.

3.5 INSTALLATION OF FIRE PUMP TEST CONNECTION

.1 Provide an exterior wall mounted test connection assembly for the fire pump set where shown. Confirm exact location prior to roughing-in.

.2 Provide a shut-off valve in test connection piping in an accessible location, adjacent the pump set, and provide a check valve with ball drip between the shut-off valve and the test connection assembly. Extend drainage piping from the outlet of the ball drip to the nearest suitable floor drain.

.3 Attach a 150 mm (6") square laminated red-white plastic plate to the valve handle. Engrave the plate to read: "FIRE PUMP TEST HEADER SHUT-OFF-VALVE - NORMALLY CLOSED".

3.6 INSTALLATION OF FLOW ALARM SWITCH(ES)

.1 Provide water flow alarm switch(es) in accessible location(s) in zone piping where shown. Install in accordance with the manufacturer's instructions and connect with piping as indicated.

.2 Adjust to suit site water pressure conditions. Check and test operation.

.3 Identify each switch with a 150 mm (6") square red-white laminated engraved plastic tag. Confirm wording prior to manufacturer.

3.7 CHEMICAL RESISTANT CORROSION COATING

.1 All exposed piping and equipment installed in the areas subject to water spray, humid and or corrosive environment locations shall be treated, painted and coated with chemical resistant base and top coatings in accordance with the Sections 099000 and 099656.

3.8 DEMONSTRATION

.1 Engage a factory-authorized service representative to train City's maintenance personnel to adjust, operate, and maintain fire pump systems.

END OF SECTION

1 General

1.1 SUMMARY

.1 Related Documents:

.1 Drawings and general provisions of the Contract including General and Supplementary conditions and all Division Specifications Sections apply to this Section.

.2 This section covers the Contractor's responsibility for commissioning; each subcontractor or installer responsible for installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item

.3 Review these documents for coordination with additional requirements and information that apply to work under this Section.

.2 Section Includes:

.1 General requirements that apply to implementation of commissioning of plumbing systems, assemblies and components.

.2 The Commissioning Authority (CxA) will direct and coordinate all commissioning activities with the assistance of the Contractor; the CxA will provide the prefunctional checklists similar to samples included within this spec section and the functional test plans for the Contractor's usage. Refer to section 01 91 00 for General Commissioning Requirements and CxA Responsibilities.

.3 Related Sections:

.1 Division 01 General Requirements

.2 Division 21 Fire Suppression

.3 Division 22 Plumbing

.4 Division 23 HVAC

.5 Division 25 Integrated Automation

.6 Division 26 Electrical

.7 Division 28 Electronic Safety and Security

1.2 REFERENCES

.1 General:

.1 The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

.2 Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

.3 Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

.4 Refer to Division 22 Section "Common Results for Plumbing" for codes and standards, and other general requirements.

.2 Standards

.1 ASHRAE Guideline 0 – The Commissioning Process, 2013

.2 ASHRAE Guideline 1.1 – The HVAC&R Technical Requirements for the Commissioning Process, 2012

.3 ASHRAE Standard 202 - Commissioning Process for Building and Systems, 2013

.4 CSA Z320-11 – Building Commissioning

.5 CaGBC LEED V4 BD+C

1.3 DESCRIPTION

.1 The purpose of commission is to ensure the City that work has been completed as specified and that systems are functioning in the manner as described in Division 22 Section "Common Results for Plumbing" and specified system operating criteria. It will assist operating staff training and familiarization with new systems. It will serve as a tool to reduce post-occupancy critical systems operational difficulty or failure. It will, also, be used to develop test protocol and record the associated test data in an effort to advance the building systems from a state of substantial completion to a full dynamic operation.

.2 Commission will commence after plumbing systems have been started up, including completed leakage and pressure test reports.

.3 Commissioning work shall include, but not be limited to:

.1 Attendance at all Commissioning Meetings

.2 Preparation of Commissioning Plan.

.3 Preparation of Commissioning Schedule.

.4 Development and completion of Commissioning Report forms and check sheets for each system and piece of equipment.

.5 Demonstration to the City and Contract Administrators that the equipment/systems have been installed per contract documents.

.6 Preparation of O&M Manual.

.7 Preparation of Record Drawings.

.8 Start-up and verification of systems and equipment.

.9 Performance testing of equipment.

.10 Review and verification of Testing, Adjusting and Balancing work and report.

.11 Correction of all deficiencies and performance deviations.

.12 Demonstration and training to the City and Contract Administrator of all systems and equipment provided in this Division.

.13 Preparation and assembly of Commissioning Documentation.

.14 Coordinate with and assist Division 21 - Fire Suppression, Division 23 - HVAC, Division 25 - Integrated Automation, and 26 - Electrical for Commissioning of their respective works.

.4 The steps associated with commissioning are outlined below:

.1 Installation Verification

.2 System Start-Up.

.3 Functional Performance Testing. Issues Review and Retesting

.4 Operations and Maintenance Manual Review

.5 Building Operations Demonstration and Training

.6 Seasonal Testing and Warranty Review (as required)

.5 Operational staff training is essential to the commission process and will run concurrently with the commissioning milestones listed above.

.6 The Commissioning Team will include representatives of the City, Construction and Installing Subcontractors, Test and Balance Subcontractor, FMCS Subcontractor and Construction Subcontractor's Commissioning Agent. Equipment manufacturer's representatives will be present for start-up as specified in the equipment specification sections and for equipment training.

1.4 SYSTEMS TO BE COMMISSIONED

.1 Commissioning will be performed on the following systems:

.1 Domestic Water Pumps

.2 Water Heaters

.3 PRVs

.4 Water Meters

.5 Plumbing Fixtures

.6 Fuel Systems (diesel and/or natural gas)

1.5 SUBMITTALS

.1 Construction Schedule with Commissioning Milestones

.2 Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

.3 Calibration certifications of all testing equipment to be used during functional testing period

.4 Equipment Factory Acceptance Tests

.5 Start up and testing procedures

.6 Start-Up Reports including but not limited to Manufacturer Start-Up Reports, prefunctional checklists, pressure and leakage tests, BAS point to point verification reports and graphics and TAB reports for CxA Approval and Review.

.7 Method of Procedures as required for any required shut-downs for testing

.8 Training Requirements, agenda, and schedule

.1 Draft Training Plan: In addition to requirements specified in Section 01 7900, include:

.1 Follow the recommendations of ASHRAE Guideline 1.

.2 Manufacturer's recommended training.

.3 Demonstration and instruction on function and overrides of any local packaged controls not controlled by the BAS control system.

.9 Training Manuals: See Section 01 79 00 for additional requirements.

.1 Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

.10 Operations and Maintenance Manuals

.1 Refer to Division 01 Section "Closeout Procedures," Division 01 Section " General Commissioning Requirements," and Division 22 Section "General Requirements" for requirements for O&M manuals.

2 Products

2.1 COMMISSIONING PLAN

.1 The commissioning plan shall outline the organization, scheduling, team members, and documentation pertaining to the overall commissioning process.

2.2 NARRATIVE DESCRIPTIONS

.1 A narrative description of the design intents of the systems and their intended modes of sequences of operation.

2.3 PREFUNCTIONAL CHECKLISTS

.1 Draft Prefunctional Checklists and Functional Test Procedures for Plumbing System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the system prior to full system Functional Testing; include at least the following for each type of equipment controlled:

.1 System name.

.2 List of devices.

.3 Step-by-step procedures for testing each piece of equipment including:

.4 Process of verifying installation including piping, fixtures, valves, gages, and insulation

.5 Copy of proposed log and field checkout sheets to be used to document the process;

.6 Description of the instrumentation required for testing.

.7 Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.

2.4 FUNCTIONAL TEST PLANS (FTPS)

.1 The FTP procedures at the minimum shall consist of the following sections:

.1 Report Information:

.1 This section of the cover page provides general information on the functional test plan with respect to the project information including site and equipment location.

.2 Revision Information:

.1 This section of the cover page indicates to the reader if the functional test plan has been updated or revised

.3 Testing Approval:

.1 This section of the cover page provides a commissioning team sign-off to indicate the functional testing to the assigned equipment has been completed with all outstanding issues found addressed. / resolved.

.4 System Performance Approval:

.1 This section is intended to validate the equipment to be testing to ensure all components are accurate to the contract documents.

.5 Prefunctional Checklist:

.1 This section indicates the prefunctional check on the associated equipment to for the functional test plan. It will provide a confirmation of the readiness of the equipment for integrated systems testing by verifying that all required prefunctional checks have been completed and that the equipment can proceed into the testing phase.

.6 Functional Performance Test Plan:

.1 This section shall provide information on the reference documents used to create the functional test plan.

.7 Occupancy Schedule :

.1 This section will outline the operational hours desired for this equipment as desired by the City.

.8 System Set Points:

.1 This section will outline the required operational set point and ranges for the equipment as outlined by the Contract Administrator.

.9 Balancing Review

.1 This section will confirm that the balancing report have been received, reviewed and that the actual measurements are meeting the design. This section will summarize that balancing of the equipment and system has been sufficiently completed.

.10 Sensor Calibration

.1 This section will review and check the sensors from the Operator Work Station and physically at the sensor location to confirm equipment tie in and operation on the Building Automation System and Building Operation user-ability.

.11 Device Calibration:

.1 This section will review and check the points from the Operator Work Station and physically at the device location to confirm equipment tie in and operation on the Building Automation System and Building Operation user-ability.

.12 Trend Log Verification

.1 This section shall verify the BAS points with trending capability.

.13 Functional Performance Sequence verification:

.1 This section will provide:

.1 Sequential steps required to set parameters and conditions required to test component and functions throughout intended ranges of operation.

.2 Full range of checks and tests carried out to determine if electric and pneumatic connections, components, subsystems, systems and interfaces between systems function in accordance with the contract documents and design intents.

.3 All modes and sequences of control operations, interlocks and conditional control responses and specified responses to abnormal emergency conditions.

.14 Control Sequence and Drawings:

.1 This section provides a record and reference of all sequences and drawings used and tested for the functional test plan.

2.5 ISSUES LOG:

.1 This section records notes or remarks during system commissioning.

.2 List systems modifications, not required by the Contract Documents, but provided by the Subcontractor. List other questions regarding such system modifications.

.3 List problems discovered during Commissioning that were corrected.

.4 List problems discovered during Commissioning that were not corrected.

.5 List recommended party that should take action on these problems.

3 Execution

3.1 GENERAL

.1 The Subcontractors shall be responsible for performing procedures presented in specification and contract drawings as detailed in the Functional Test Plan (FTP) FTP. Members of the designated Commissioning Team shall witness various portions of the commissioning process. Responsibilities for these activities are listed in the following paragraphs. Commissioning Team members shall

sign-off on appropriate sections after verifying installation, operation, or documentation. Final sign-off shall be by the City and Commissioning Agent.

.2 Any test ports, gauges, test equipment, etc., needed to accomplish the functional performance tests shall be provided by Subcontractors.

.3 Subcontractors shall provide to the Commissioning Team documentation of calibration of controls. Documentation shall include dates, setpoints, calibration coefficients, control loop verification, and other data required to verify system check-out. Documentation shall be dated and initialed by field engineer or technician performing the work.

3.2 OPERATIONAL STAFF TRAINING

.1 System narrative descriptions will be prepared by the Commission Agent and supported by flow diagrams, one line diagrams, and appropriate specification sections for major systems to be commissioned. The Commission Agent will coordinate “system description” meetings with members of facility management and maintenance department groups to review system description documentation. The meetings will provide an overview of major system features, components, and arrangements.

.2 The Subcontractor and associated manufacturer’s representatives shall provide required training to operational staff after the system description meetings have occurred. The Subcontractor training sessions shall provide a more detailed analogy of systems operation and maintenance.

3.3 INSTRUMENTATION

.1 Instrumentation will be provided by the Subcontractor. Instruments used for measurements shall be accurate. Calibration histories for each instrument shall be available for examination. Calibration and maintenance of instruments shall be in accordance with the requirements of NEBB or AABC Standards.

.2 Application of instruments and accuracy of measurements shall be in accordance with NEBB or AABC Standards.

3.4 DOCUMENTATION

.1 The installing Subcontractor shall be responsible for collection of pertinent data during system start-up and functional performance testing. The Subcontractor shall submit to the Commissioning Agent documentation of tests performed prior to and after system start-up. Documentation shall also include start-up procedures as approved by Commissioning Team.

.2 Documentation is to be typewritten on 8-1/2 by 11 inches (200 by 280 mm) paper and inserted in a 2 inches (50 mm) to 3 inches (75 mm) thick three ring binder. Indicate the project name, number, volume number, and volume title on the end panel of each binder.

.3 Provide a title sheet for each volume and list the following:

.1 Volume Title and Section Name and Number requiring this submittal.

.2 Project name, project number, and address.

.3 Subcontractor name, address, and phone number.

.4 Name, title, signature, and date of person making the submittal.

.5 Name of the City, a blank line for signature, and the date of person accepting the submittal.

.6 Name, address, and phone number of Commission Agent; a blank line for signature; and date of person accepting the submittal.

.4 Provide a Table of Contents for multiple submittals. List each submittal and page number. Number each page, centered on the bottom in sequential numerical order. Provide tabs for multiple submittals in a single binder.

3.5 INSTALLATION VERIFICATION

.1 General Commissioning responsibilities:

.1 Before system start-up begins, the Commission Team shall conduct a final installation verification audit. The Subcontractor shall be responsible for completion of work including change orders and punch list items to the City's satisfaction. The audit shall include, but not be limited to, checking of:

.1 Piping specialties including balance, control, and isolation valves.

.2 Ductwork specialty items including turning devices, balance, fire, smoke, control dampers, and access doors.

.3 Control sensor types and location.

.4 Identification of piping, valves, equipment, controls, etc.

.5 Major equipment, pumps, valves, starters, gauges, thermometers, etc.

.6 Documentation of prestart-up tests performed, including manufacturer's factory tests.

.2 If work is found to be incomplete, incorrect, or non-functional, the Subcontractor shall correct the deficiency before system start-up work proceeds.

3.6 SYSTEM START-UP

.1 General Commissioning Responsibilities:

.1 A start-up plan shall be developed and submitted by the installing Subcontractor. Start-up plan to include the following:

.1 Flushing and cleaning of pipe.

.2 Filters, strainers, and screens.

.3 Valve/damper positions.

.4 Electrical tests.

.5 Pressure tests.

.6 Safeties.

.7 Chemical treatment.

.8 Manufacturer's tests.

.2 The start-up plan will be reviewed and a prestart-up inspection performed by designated members of the Commissioning Team. The installing Subcontractor shall commence with system start-up after approval has been given to start-up plan and the prestart-up inspection is completed. Designated members of the Commissioning Team shall witness system start-up and list system and equipment deficiencies noted during start-up. The Subcontractor shall take corrective action on system deficiencies noted and demonstrate to the Commissioning Team members suitable system operation.

.3 Designated systems requiring test and balance work shall have this activity commence after systems have successfully completed start-up. System and equipment deficiencies observed during this activity is to be noted and corrected.

3.7 FUNCTIONAL PERFORMANCE TESTING

.1 General Commissioning Responsibilities:

.1 Functional Testing begins after operational testing, adjusting, and balancing of the systems have been completed by the Subcontractors; and the System Description and Hands-on Training sessions have been completed.

.2 The objective of the Functional Testing is to advance the building systems from a state of substantial completion to full dynamic operation in accordance with the specified design requirements and design intent.

.3 Attaining this object will be accomplished by developing individual systems testing protocols which, when implemented by the Subcontractor, will allow the Commissioning Team to observe, evaluate, identify deficiencies, recommend modifications, tune, and document the systems and systems equipment performance over a range of load and functional levels.

.4 Functional Performance tests for the systems to be commissioned are defined in the Commissioning Plan. These tests are intended to be conclusive but may require minor modifications as system operation dictates.

.2 Corrective action:

.1 Take correct action as necessary to rectify items noted in the Issues Log at no additional charge to the City

3.8 MONITORING BASED COMMISSIONING

.1 The CxA will develop MBCx procedures and document them in the Commissioning Plan.

.2 The subcontractors will install and calibrate all metering and sensor devices according to the manufacturer's instructions. Defective devices will be recalibrated or replaced.

.3 The Controls Subcontractor will setup all required BAS points, trend logs, graphs, reports and other items as may be required to support the MBCx effort.

.4 For a period of one year after occupancy, the City or Contract Administrator will review building operation and trend logs (typically monthly) to confirm proper operation of the building systems. Any need for re-training of the City's staff or operations team will also be identified.

.5 Deficiencies will be documented in the issues log and will be corrected by the responsible subcontractor at no additional cost to the City. The issues log will be reviewed by the City, Contract Administrator, Contractor and subcontractors, and CxA.

3.9 OPERATIONS AND MAINTENANCE MANUALS

.1 Refer to Division 01 Section "Closeout Procedures," Division 01 Section " General Commissioning Requirements," and Division 22 Section "General Requirements" for requirements for O&M manuals.

3.10 OPERATIONAL STAFF TRAINING

.1 System narrative descriptions will be prepared by the Commission Agent and supported by flow diagrams, one line diagrams, and appropriate specification sections for major systems to be commissioned. The Commission Agent will coordinate "system description" meetings with members of facility management and maintenance department groups to review system description documentation. The meetings will provide an overview of major system features, components, and arrangements.

.2 The Subcontractor and associated manufacturer's representatives shall provide required training to operational staff after the system description meetings have occurred. The Subcontractor training sessions shall provide a more detailed analogy of systems operation and maintenance.

.3 Re-Training. The MBCx effort may identify the need for re-training. The responsible subcontractor and/or vendor will provide re-training at no additional cost to the City.

3.11 SYSTEMS MANUAL

.1 The Systems Manual is intended to be a usable information resource containing all of the information related to the systems, assemblies, and commissioning process in one place with indexes and cross references. The systems manual will be developed by the CxA with assistance from the Contract Administrator and the City's representatives.

3.12 LESSONS LEARNED

.1 A lessons learned review is held on site with the entire Commissioning Team in attendance after completion of all commissioning activities and before the end of the warranty period. The purpose of the review session is to obtain honest, objective, and constructive feedback on the effectiveness of the commissioning process used and changes that will improve the delivered project. The CxA

documents the issues, benefits, and recommendations of this session for inclusion in the final commissioning report.

3.13 WARRANTY REVIEW

.1 During the warranty period, seasonal testing and other deferred testing required is completed according to the specifications. Tests are executed and deficiencies corrected by the appropriate subs, witnessed by the CxA. Any final adjustments to the O&M manuals and as-builts due to the testing are made. Approximately 10 months into the warranty period, a one day review session is held on site to review systems operation with O&M staff prior to expiration of the warranty.

3.14 SEASONAL / DEFERRED TESTING

.1 Unforeseen Deferred Tests: If any test cannot be completed due to the building structure, required occupancy condition, or other deficiency, the functional testing may be delayed upon approval of the City. These tests are conducted in the same manner as the seasonal tests as soon as possible.

.2 Seasonal Testing: Seasonal variation in operations or control strategies may require additional testing during the opposite season to verify performance of the HVAC system and controls. During the warranty period, seasonal testing and other deferred testing is completed as required to fully test all sequences of operation. Operation coordinates these activities. Tests are executed and documented, with deficiencies corrected by the appropriate contractors. Any final adjustments to the O&M manuals and as-builts due to the testing are also completed.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 22 08 00 – Commissioning of Plumbing.

.3 Section 22 11 19 – Domestic Water Piping Specialties.

.4 Section 22 11 20 – Domestic Water Expansion Tanks.

.5 Section 22 11 23 – Domestic Water Pumps.

.6 Section 22 34 36 – Domestic Hot Water Heaters and Storage Tanks.

1.2 REFERENCE STANDARDS

.1 ANSI/ASME

.1 ANSI/ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings.

.2 ANSI/ASME B16.22 Wrought Copper and Cooper Alloy Solder-Joint Pressure Fittings.

.2 ANSI/AWS

.1 ANSI/AWS A5.8M/A5.8, Filler Metals for Brazing and Braze Welding.

.3 ASTM International Inc.

.1 ASTM A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

.2 ASTM A403 / A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.ASTM A743/A743A, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

.3 ASTM B16.9, Factory-Made Wrought Buttwelding Fittings.

.4 ASTM B75 Standard Specification for Seamless Copper Tube

.5 ASTM B88, Standard Specification for Seamless Copper Water Tube.

.6 ASTM F492, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.

.7 ASTM F876, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

.8 ASTM F877, Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems.

.9 ASTM F1960 Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing.

.10 ASTM F1969, Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing.

.11 ASTM F3226, Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems

.4 American Water Works Association (AWWA)

.1 AWWA B-300, Hypochlorites.

.2 AWWA, C900: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

.5 Canadian Standards Association (CSA International)

.1 CAN/CSA B64, Backflow Preventers and Vacuum Breakers

.2 CAN/CSA B137.2: Polyvinylchloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications.

.3 CAN/CSA B137.3: Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications

.4 CAN/CSA-B137.5 Cross-Linked Polyethylene (PEX) Tubing Systems for Pressure Applications

.5 CAN/ CSA B356: Water Pressure Reducing Valves for Domestic Water Supply Systems

.6 ASME A112.18.1/CSA B125.1-2012, Plumbing Supply Fittings

.7 CAN/ULC-S102.2, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies

.8 CAN/ULC-S115, Standard Method of Fire Tests of Firestop Systems

.6 IAPMO

.1 IAPMO PS 117 Press and Nail Connections

.7 ISO

.1 ISO 9001 Quality Management Systems

.8 National Building Code 2015 (NBC)

.9 National Sanitation Foundation (NSF International)

.1 NSF/ANSI 14, Plastics Piping System Components and Related Materials.

.2 NSF/ANSI 61, Drinking Water System Components – Health Effects.

1.3 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Provide the manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHIMS MSDS – Materials Safety Data Sheets.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 77 00 – Closeout Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 – Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 PIPING AND FITTINGS

.1 Ductile Iron: Centrifugally cast ductile iron to ANSI/AWWA C151/A21.51 complete with ANSI/AWWA C104/A21.4 cement lining, and ANSI/AWWA C105/A21.5 protective polyethylene film

(minimum nominal thickness of 200 microns and minus tolerance with 10 percent). Fittings to be cement lined ductile-iron/cast-iron mechanical joint fittings to ANSI/AWWA C110/A21.10. Rubber gasket joints for cast-iron or ductile-iron water pipes shall conform to ANSI/AWWA C110/A21.11.

.2 PVC – Gasket Joint: ULC listed, rigid, Class 150, DR18, 1035 kPa (150 psi) pressure rated bell and spigot pattern PVC pipe and CSA certified fittings to CSA B137.2, CSA B137.3 and AWWA C900, complete with gasket joints and a mechanical restraint collar for each thrust block required in accordance with Part 3 of this Section.

.1 Acceptable Manufacturers

.1 Ipex Inc. “BLUE BRUTE” Gasketed Pressure Pipe (Formerly Canron and Scepter)

.2 Rehau “AQUALOC” Gasketed Pressure Pipe

.3 NAPCO “COID” PVC Pressure Pipe (Formerly North American Pipe Corporation and Royal Pipe & Fittings)

.3 Stainless Steel – Grooved Joint: Type 304/316 Schedule 10S, ASTM 312, factory or site roll grooved, ASTM A743. Complete with stainless steel grooved end fittings and unless otherwise specified stainless steel mechanical joint couplings with EPDM gaskets suitable for potable water service. Gaskets to be NSF 61 listed and rated for temperatures from -35°C to 121 °C (-30°F to 250°F).

.1 Acceptable Manufacturers

.1 Victaulic Style 489

.2 Gruvlok 7400SS

.3 Tyco Grinnell 472

.4 Shurjoint #SS-7

.4 Stainless Steel – Welded Joint: Type 304/316 Schedule 10S, ASTM 312, mill or site beveled, complete with factory made seamless stainless steel, butt welding fittings to ASTM A403M & ASME B16.9, long sweep pattern wherever possible, and welded joints. For underground applications Schedule 40 piping shall be used in place of Schedule 10S and piping shall be wrapped in corrosion-resistant PVC pipe tape. PVC pipe tape shall be minimum 0.25 mm (10 mil) thick, suitable for direct burial, and resist corrosion (by means of water, salts, alkalis, dielectric contact, and soil acids), moisture, bacteria, fungus, abrasion and UV (sunlight).

.5 Stainless Steel – Press Joint: Type 304/316 Schedule 10S, ASTM 312, mill or site beveled, complete with stainless steel press fittings conforming to the material, sizing, and performance requirements of ASTM F3226 and IAPMO PS 117. Sealing elements for pressing fittings shall be EPDM and shall be factory installed or supplied by fitting manufacturer. Press fittings shall feature a design leakage path, assuring leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. System to be listed to NSF/ANSI 61 and to be rated to a minimum of 200 psi.

.1 Acceptable Manufacturers

.1 Viega Llc. “MegaPress Stainless 316”

.2 Victaulic “Vic-Press for Stainless Steel”

.6 Type “K” Soft Copper: Type “K” soft copper to ASTM B88, supplied in a continuous coil with no joints if possible, and complete with, if joints are required, compression type flared joint couplings.

.7 Copper - Solder Joint: Type “L” hard drawn seamless copper to ASTM B88, complete with wrought copper solder joint pressure fittings, ANSI/ASME B16.22 or cast copper alloy solder joint pressure fittings, ANSI/ASME B16.18.

.1 Soldered joints made using 96-0.5-4 tin silver copper, 95-5 tin antimony, 96-6 tin silver, or 96-4 tin silver solder, conforming to ASTM B32 for pipes less than 100mm (4 in.).

.2 Brazing joints made using 80-15-5 copper silver phosphorus brazing rod, conforming to ANSI/AWS A5.8M/A5.8 for pipes 100mm (4 in.) and up.

.8 Copper – Press Joint: Type "L" hard drawn seamless copper to ASTM B88, complete with wrought copper press fittings (ANSI/ASME B16.22) or cast copper alloy press fittings (ANSI/ASME B16.18) conforming to the performance criteria of IAPMO PS 117. Sealing elements for pressing fittings shall be EPDM and shall be factory installed or supplied by fitting manufacturer. Press fittings shall feature a design leakage path, assuring leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. System to be listed to NSF/ANSI 61 and to be rated to a minimum of 200 psi.

.1 Acceptable Manufacturers

.1 Viega Llc. "ProPress"

.2 Nibco Inc. "Press Fittings"

.9 Copper - Grooved Joint: Type "L" hard drawn seamless copper to ASTM B88, complete with shop or site roll grooved ends. Grooved end fittings conforming to ASTM B75. Couplings to be designed with angle bolt pads to provide a rigid joint, sealed with an EPDM gasket suitable for potable water service. Gaskets rated for temperatures from -35°C to 121 °C (-30°F to 250°F). System to be listed to NSF/ANSI 61.

.1 Acceptable Manufactures

.1 Victaulic "Copper Connection" Style 606 of Style 607

.2 Gruvlok "RIGIDLITE" Fig. 7400

.3 Tyco Grinnell 672

.4 Shurjoint #C301

.10 Potable-grade PEX:

.1 Tube Materials: Tube shall be cross-linked polyethylene (PEX) manufactured by PEX-a or peroxide method.

.1 PEX tubing shall be ASTM F876 tested and approved for excessive temperature and pressure for 725 hours at 210°F (99°C) @ 1035 kPa (150 psi).

.2 PEX tubing shall be manufactured in accordance with ASTM F876, ASTM F877 and CAN/CSA-B137.5. The tube shall be listed to ASTM by an independent third party agency.

.3 PEX tubing shall be listed to both NSF/ANSI 14 and 61.

.4 PEX tubing shall have Standard Grade hydrostatic design and pressure ratings of 82°C (200°F) at 551 kPa (80 psi), 82°C (180°F) at 689 kPa (100 psi), and 23°C (73.4°F) at 1102 kPa (160 psi). Temperature and pressure ratings shall be issued by the Plastic Pipe Institute (PPI), a division of the Society of the Plastic Industry (SPI).

.5 Minimum bend radius for cold bending of the PEX tubing shall not be less than six (6) times the outside diameter. Bends with a radius less than stated shall require the use of a bend support as supplied by tube manufacturer.

.2 PEX tube dimensions 12 mm (½ in.) to 25mm (1 in.) shall be in accordance with ASTM F876 and ASTM F877.

.3 When used in buildings of non-combustible construction all PEX tubing stall be listed to CAN/ULC S102.2, achieving a Flame Spread Rating not exceeding 25 and achieving a Smoke Developed Classification not exceeding 50. All conditions required to meet the listing shall be strictly adhered to (eg. minimum 457 mm (18 in.) spacing between PEX runs). The PEX tubing shall meet the Flame Spread Rating and Smoke Developed

Classification as an independent component, using an addition component/material to meet these requirements is unacceptable (eg. plenum wrap, insulation, water-filled pipe, etc.). All firestops shall be approved by CAN/ULC-S115.

.4 Pre-Sleeved Tubing: All PEX tubing that is encased in concrete or buried underground shall be pre-sleeved in corrugated polyethylene tubing.

.5 Fitting Materials: Fittings, including manifolds and multi-port tees, shall be manufactured of Engineered Polymer (EP). Stainless steel materials are allowed only for transition fittings. Fitting connections shall be made to the requirements of ASTM F1960.

.6 Fittings shall be supplied by the PEX tubing manufacturer.

.7 PEX-a cold expansion type fittings shall be an assembly consisting of insert and PEX-a cold expansion ring.

.8 Acceptable Manufacturers:

.1 UPONOR Ltd. (Wirsbro)

.2 REHAU Group

.3 AQUATHERM

.4 PERMA-PIPE, Inc.

3 Execution

3.1 PIPING MATERIALS AND JOINT TYPES

.1 Above grade piping, unless otherwise specified, is to be as follows:

.1 Domestic water, 25 mm (1 in.) and smaller, less than 1380 kPa (200 psi) working pressure:

.1 “Copper - Solder Joint” piping shall be used.

.2 Alternatively “Copper - Press Joint” piping may be used.

.3 Where permitted by local building code/AHJ and when working pressures are below 1034 kPa (150 psi) “Potable-grade PEX" piping may be used as an acceptable alternative for trap priming lines or undergrounds runs to non-freeze wall hydrants (NFWHs) along perimeter of building (runs to NFWHs shall be installed in HDPE sleeve to allow for removal and replacement of the tubing if required).

.2 Domestic water, larger than 25 mm (1 in.) up to and including 75mm (3 in.), less than 1380 kPa (200 psi) working pressure:

.1 Shall use Copper - Solder Joint piping.

.2 Alternatively “Copper - Press Joint”, “Copper – Grooved Joint”, “Stainless Steel – Grooved Joint”, “Stainless Steel – Welded Joint”, or “Stainless Steel – Press Joint” piping may be used.

.3 Domestic water, 100 mm (4 in.), less than 1380 kPa (200 psi) working pressure:

.1 Shall use Copper – Grooved Joint piping.

.2 Alternatively “Copper – Solder Joint”, “Copper - Press Joint”,“Stainless Steel – Grooved Joint”, “Stainless Steel – Welded Joint”, or “Stainless Steel – Press Joint” piping may be used.

.4 Domestic water, 150mm (6 in.) and larger, less than 1380 kPa (200 psi) working pressure:

.1 Shall use Stainless Steel – Grooved Joint piping.

.2 Alternatively, “Stainless Steel – Welded Joint”, or “Stainless Steel – Press Joint” piping may be used.

.2 Underground piping, unless otherwise specified, is to be as follows:

.1 Domestic water, 75 mm (3 in.) and smaller within building footprint and to points outside the building lines shall use Type “K” Soft Copper piping, alternatively Potable-grade PEX piping designed for underground installation may be used. All non-metallic piping shall be changed to metallic piping prior to entering the building.

.2 Domestic water, 100 mm (4 in.) and larger within the building footprint and to points outside the building lines shall use PVC – Gasket Joint piping except for transition into building which shall be “Ductile Iron” or “Stainless Steel – Welded Joint”.

.3 All non-metallic piping shall be changed to metallic piping prior to entering the building using an EBAA Iron Inc. Mega-Coupling Series 3800 Restrained Coupling or acceptable equivalent. (i.e., changed before passing through basement floor or slab on grade). Acceptable Manufacturers:

.1 EBAA Iron Inc.

.2 Krawusz Inductries Ltd. (Hymax)

.3 The Ford Meter Box Company

3.2 GENERAL PIPING INSTALLATION REQUIREMENTS

.1 Provide all required potable water piping.

.2 Slope all piping so that it can be completely drained

.3 Unless otherwise specified in the Contract Documents, locate and arrange horizontal pipes above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained.

.4 Unless otherwise specified in the Contract Documents, install all work concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer to and examine the Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.

.5 Install all pipes and ducts parallel to building lines (all piping shall run parallel with closest wall).

.6 Piping in walk-in pipe spaces shall be installed as close to one wall as possible.

.7 Neatly group and arrange all exposed Work.

.8 Locate all valves and any other equipment which will or may need maintenance or repaired in accessible spaces, equipment shall be easily accessible from access doors. Where valves and similar piping accessories occur in vertical service spaces (ie. in shafts, pipe spaces or partitions) locate the accessories at the floor level.

.9 Make all connections between pipes of different materials using proper approved adapters. Provide proper dielectric unions in all connections between copper pipe and ferrous pipe or equipment. Dielectric fitting to conform to ASTM F492 complete with thermoplastic liner.

.10 Ensure that the equipment and material manufacturers' installation instructions are followed unless otherwise specified in this Section or on the Drawings, and unless such instructions contradict governing codes and regulations.

.11 Carefully clean all pipes and fittings prior to installation. Temporarily cap or plug ends of pipes and equipment which are open and exposed during construction.

.12 Install piping which is to be insulated so that they have sufficient clearance to permit insulation to be applied continuously and unbroken around the pipe, except at fire barriers, in which case the insulation will be terminated at each side of the fire barrier.

.13 Inspect surfaces and structure prepared by other trades before performing the work of this Section. Verify that surfaces or the structure to receive the work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing to the Contract Administrator/ Engineer. Installation of the work shall constitute the Contractor's acceptance of such surfaces as being satisfactory.

3.3 UNDERGROUND PIPING INSTALLATION REQUIREMENTS

.1 The following publications shall be used to establish class of bedding and class of piping for installation other than the above. They shall also serve as guide for preparation of bedding, installation and testing.

.1 The Blue Brute installation Guide by Johns-Manville.

.2 Pipe passing under a driveway or parking lot with less than 1.5 m (5 ft.) of cover shall be encased in 150 mm (6 in.) of 13,800 kPa (2000 psi) concrete on top, bottom and sides.

.3 Provide thrust blocks of 20 MPa (3000 psi) concrete at each tee, elbow, valve and other fitting where thrust forces could occur. Thrust blocks shall be sized to suit the local authorities requirements, but in no case be smaller than 150 mm (6 in.) greater on all sides than the pipe served.

.4 Tracer Wire for PVC and PEX U/G Pipe (excluding trap priming lines and pipes installed in a secondary containment tube allowing for complete pipe replacement from above grade): Prior to backfilling, secure light coloured plastic insulated #10 ga. TW solid copper wire or seven strand insulated copper wire to the top of all buried PVC and PEX pipes secured to the top of the pipe with plastic type ties for the entire length of the pipe for pipe location tracing purposes. Terminate in a round or square non-metallic PVC floor box, flush mounted with a brass cover plate. Coil 450 mm (18 inches) of wire inside box.

.5 Lay pipes true to line and grade with bells upgrade. Fit sections together so that, when complete, the pipe has a smooth and uniform invert. Keep pipe thoroughly clean so that jointed compound will adhere. Inspect the pipe for defects before being lowered into the trench. Do not use deflective pipe.

3.4 PIPE JOINT REQUIREMENTS

.1 For pipes travelling perpendicular (through) walls or slabs do not make pipe joints inside the wall or slab. Pipe joints can be made inside a wall while the pipe is travelling parallel to the wall, concealed inside.

.2 Ream all piping ends prior to making joints.

.3 Properly cut threads in screwed steel piping and coat male threads, unless otherwise specified in the Contract Documents, with red lead, Teflon tape or paste, or an equivalent thread lubricant. After the pipe has been screwed into the fitting, valve, union, or piping accessory, not more than two pipe threads are to remain exposed.

.4 Unless otherwise specified in the Contract Documents, make all soldered joints in copper piping using flux suitable for and compatible with the type of solder being used. Clean the outside of the pipe end and the inside of the fitting, valve, or similar accessory prior to soldering.

.5 Install mechanical joint fittings and couplings in accordance with the manufacturer's instructions.

.6 If grooved fittings and couplings are used, ensure that all valves and piping accessories are suitable. Grooves shall be rolled. Make arrangements with the coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required, and adhere to the manufacturer's instructions with respect to pipe grooving, support, anchoring and guiding the grooved piping system. Note that all grooved end piping system products shall be supplied by a single manufacturer who is operating to an ISO 9001 program.

3.5 PRESSURE TESTS

.1 Conform to requirements of Section 20 05 00 – General Mechanical Requirements.

.2 Test pressure: Shall be the larger value of 150% maximum system operating pressure or 860 kPa.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 22 08 00 – Commissioning of Plumbing

.3 Section 22 11 16 – Domestic Water Piping.

.4 Section 22 11 20 – Domestic Water Expansion Tanks.

.5 Section 22 11 23 – Domestic Water Pumps.

.6 Section 22 34 36 – Domestic Hot Water Heaters and Storage Tanks

1.2 REFERENCE STANDARDS

.1 American Society of Testing and Materials (ASTM)

.1 ASTM A743/A743A, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

.2 American Water Works Association (AWWA)

.1 AWWA C701, Cold Water Meters – Turbine Type

.2 AWWA C702, Cold Water Meters – Compound Type

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA B64, Backflow Preventers and Vacuum Breakers

.2 CAN/ CSA B356: Water Pressure Reducing Valves for Domestic Water Supply Systems

.3 ASME A112.18.1/CSA B125.1-2012, Plumbing Supply Fittings

.4 National Sanitation Foundation (NSF International)

.1 NSF/ANSI 61, Drinking Water System Components – Health Effects

.2 NSF/ANSI 372, Drinking Water System Components – Lead Content

.5 National Building Code

1.3 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings:

.1 Provide the manufacturer's printed product literature and datasheets for equipment, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 77 00 – Closeout Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 – Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 SHUT-OFF VALVES

.1 Ball Valves: Lead Free Class 600, 4140 kPa (600 psi) WOG rated full port ball type valves, each complete with a forged brass or bronze body with solder ends, forged brass cap and blowout-proof stem, solid forged brass chrome plated ball, “Teflon” or “PTFE” seat, and a removable lever handle. Where piping is insulated provide stem extensions to clear insulation. Acceptable products are:

.1 Kitz Corporation Code No. 859.

.2 Toyo Valve Co. Fig. 5049ALF.

.3 MAS B-4LF.

.4 Nibco #S-585-80LF (Bronze).

.5 Watts Water Technologies (Canada), Inc. #LF6080, LFB6081-3C.

.2 Butterfly Valves – Lead Free, Flanged Joint: Non-corrosive, minimum 1200 kPa (175 psi) cold water pressure rated, resilient seated butterfly valves, each complete with a coated cast iron or ductile iron lug type body, stainless steel shaft, bronze disc, and EPDM seat, and each suitable for potable water bubble-tight dead end service with the valve in position and either side of the connecting piping removed. Butterfly valves to and including 100 mm (4 inch) diameter are to be equipped with lever handles. Butterfly valves larger than 100 mm (4 inch) diameter are to be equipped with worm gear operators. Where piping is insulated provide stem extensions to clear insulation. Acceptable products are:

.1 Apollo #LC149 Series.

.2 DeZurik #BOS-CL Series.

.3 Nibco Series LD-2000.

.4 MAS #LD4-A-E.

.3 Butterfly Valve – Grooved Joint Copper Piping: Victaulic Co. of Canada Series 608 “COPPER CONNECTION”, Tyco Grinnell B680, or Shurjoint Model SJ-C300, 2065 kPa (300 psi) rated butterfly valves, each complete with a cast bronze body with grooved ends, resilient elastomeric coating bonded to a ductile iron disc suitable for potable water, bubble tight shut-off, and manual lever handle. Where piping is insulated provide stem extensions to clear insulation.

2.2 CHECK VALVES

.1 Horizontal: Lead Free, Class 125, bronze, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with solder ends. Acceptable products are:

.1 Kitz Corporation Code No. 823.

.2 Nibco #S-413-Y-LF.

.3 Toyo #237A-LF

.4 Watts Water Technologies (Canada), Inc. #LF600 up to 50 mm (2 inch)

.2 Vertical: Lead Free, Bronze, 1725 kPa (250 psi) WOG rated vertical lift check valve with soldering ends. Acceptable products are:

.1 Kitz Corporation Code No. 826.

.2 Nibco #S-480-Y-LF.

2.3 DRAIN VALVES

.1 Minimum 2070 kPa (300 psi) water rated, 20 mm (3/4-inch) diameter straight pattern bronze or brass ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm (3/4-inch) diameter garden hose, and a cap and chain. Where piping is insulated provide stem extensions to clear insulation. Acceptable products are:

.1 Kitz Corporation Code 869 C/868 AC.

.2 Apollo #70-LF-100/200-HC.

.3 Nibco #S-585-80-LF.

.4 Toyo #5046-LF.

2.4 UTILITY WATER METER

.1 100mm (4 in.) Sensus (Xylem Inc.) “OMNI Compound (C2)” water meter or approved equivalent tamper-proof, in line serviceable meter suitable for connection of a remote automatic reading and billing unit. Meter shall be in accordance with AWWA Standard C701 and C702 and complete with:

.1 Cast iron main case.

.2 Stainless steel strainer with removable cover for maintenance access.

.3 A roll-sealed magnetic drive register, and a turbine measuring element.

.4 A surface wall mounting automatic meter reading and billing unit with encoder register, polycarbonate housing, roll-sealed copper shell, and ABS plastic receptacle.

2.5 SUB-WATER METER

.1 For pipe sizes up to 50mm (2 in.): Neptune Technology Group (Canada) Limited “T-10 Meter” or approved equivalent tamper-proof, in line serviceable meter suitable for connection of a remote automatic reading and billing unit and complete with:

.1 Cast bronze main case.

.2 Roll sealed register, and positive displacement mutating disc measuring chamber.

.3 An “ARB-V” surface wall mounting automatic meter reading and billing unit with encoder register, polycarbonate housing, roll-sealed copper shell, and ABS plastic receptacle.

.2 For pipe sizes 75mm (3 in.) and larger: Neptune Technology Group (Canada) Limited “HP Turbine Meter” or approved equivalent tamper-proof, in-line serviceable meter suitable for connection of a remote automatic reading and billing unit and complete with:

.1 A cast bronze main case.

.2 A turbine measuring element.

.3 An “ARB-V” surface wall mounting automatic meter reading and billing unit with encoder register, polycarbonate housing, roll-sealed copper shell, and ABS plastic receptacle.

2.6 POTABLE HOT WATER AUTOMATIC FLOW LIMITING & BALANCING VALVES

.1 Brass, Solder end type, lead free, automatic flow limiting valve, valves designed to facilitate precise flow balancing of potable hot water. Operating pressure between 2 to 80 psi. Operating temperature range between 32F to 212F. Complete with changeable GPM flow cartridges, EPDM O-Ring and diaphragm, Polyphyenylsulfone orifice and certified to NSF/ANSI 61 & 372. Acceptable products are:

.1 Caleffi AutoFlow 127 Series.

.2 Hays Fluid Controls Model 2517LF.

.2 Solder end type, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with valved ports for connection to a differential pressure meter. Certified to NSF/ANSI 61 & 372. Acceptable products are:

.1 Armstrong Fluid Technology Model CBV-S.

.2 Tour and Anderson Model TBV-S or STAD/STAS.

.3 RWV #9519AB.

2.7 INTERIOR HOSE BIBBS

.1 'HB-1'

.1 Exposed – Cold Water: Cast bronze hose bibb with hose end vacuum breaker. Acceptable products are:

.1 Zurn #Z1341.

.2 Watts Water Technologies (Canada), Inc. #SC8-1.

.3 Jay R. Smith #5673

.4 Mifab #MHY-90.

.2 'HB-2' Exposed – Hot & Cold Water: Rough Brass hose bibb with 19mm hose end complete with built-in vacuum breaker with aluminum handles. Wall thickness to suit application. Acceptable products are:

.1 Woodford Model 22

.3 HB-2: Enclosed, lockable hose bibb with vacuum breaker. Certified to ASSE, CSA and IAPMO Standards. Max Pressure 125 psi. Acceptable products are:

.1 Woodford Model 22

2.8 HOSE REELS

.1 'HBR-1' Exposed – Cold Water: Offshore type, ultra heavy duty, 304 Stainless steel corrosion-resistant material roll-formed channel frame construction hose reel of non-sparking ratchet assembly, spring retractable-spring rewind with declutching arbor to prevent damage from reverse winding. Inlet: 90° swivel joint, 25mm (1") female NPT threads and 25mm (1") Victaulic groove. Outlet: 25mm (1") female NPT threads. Standard reel construction to handle liquids at temperatures ranging from -51° C to +79° C (-60° F to +175° F) and operating pressures available up to 20.7 bar (300 psi). Construction to be with 4-way roller assembly with swivel joint suitable for wall-mounting.

.2 Each unit to be supplied with 30m (100ft) synthetic rubber hose with hose stop, adaptors, stainless steel ball valve and quick connects.

.3 Acceptable products are:

.1 Hannay Reels, # SS820-30-31-10.5REV.A TR

.2 Reelcraft, # D84000 OLS-S

.3 Coxreels

.4 Or approved equivalent

2.9 EXTERIOR NON-FREEZE GREEN ROOF HYDRANTS- RHB-1

.1 Woodford Model #RHY2-MS freezeless roof hydrant, cast iron hydrant support, cast iron underdeck flange, ¾ hose connection, hose connection dual check backflow preventer, EPDM boot cover, 1" NPT female inlet connection, 1-1/4"galvanized pipe casing, 1/8" NPT drain hole piped to the nearest drain location, rod guide, one piece variable flow plunger with large cushion type seal. Acceptable products are:

.1 Woodford Manufacturing Company.

.2 Zurn

2.10 EXTERIOR NON-FREEZE WALL HYDRANTS NFHB-1

.1 Concealed and recessed, non-freeze, key operated, lead free wall hydrant. Each hydrant shall be complete with a nickel bronze box and door, vacuum breaker, 20 mm (3/4 in.) diameter threaded hose connection, 20 mm (3/4 in.) female x 25 mm (1 in.) male pipe connection, all bronze head, seat casting and internal working parts, bronze wall casing and loose operating key. Acceptable products are:

.1 Zurn #Z1300.

.2 Watts Water Technologies (Canada), Inc. #HY-725

.3 Jay R. Smith #5509QT.

.4 Mifab #MHY-20.

2.11 VACUUM BREAKERS

.1 Threaded brass or bronze lead free 20 mm (3/4-inch) diameter hose connection vacuum breakers to CSA B64, each designed to connect to the hose bibb inlet and to be non-removable when in place. Watts Water Technologies (Canada), Inc. LF8 or acceptable equivalent.

2.12 FLOOR DRAIN TRAP SEAL PRIMERS

.1 Pressure Drop Activated (3 PSI):

.1 Mifab Manufacturing, Inc. Model M2-500, 20.7 kPa (3 psi) pressure drop activated trap seal primer, constructed of brass, non-adjustable serviceable sediment filter, 12 mm (1/2 inch) threaded inlet and outlet connections, for priming up to four traps from the same primer, and c/w a MI-DU-2 distribution unit.

.2 Mifab Manufacturing Inc. Model M1-500, 20.7 kPa (3 psi) pressure drop activated trap seal primer, constructed of brass, non-adjustable serviceable sediment filter, 12 mm (1/2 inch) threaded inlet and outlet connections, c/w a Model MI-DU distribution unit for priming 2, 3 or 4 traps and an additional 2 more MI-DU distribution units for priming 5 to 10 traps. Additional distribution units to be installed in a pyramid fashion with the two additional distribution units being fed from a primary distribution unit.

.2 Pressure Drop Activated (10 PSI):

.1 Precision Plumbing Products, Inc. Model P2-500 trap primer valve, constructed of brass, adjustable to high or low water pressures and complete with "O" ring seals, 12 mm (1/2 inch) threaded inlet and outlet connections, and, for priming two traps from the same primer, a DU-2 dual outlet distribution unit.

.2 Precision Plumbing Products Inc. Model P1-500 trap primer valve constructed as specified above for the Model P2-500 primer valve, complete with a Model DU-3 or DU-4, 3 or 4 outlet distribution unit for priming 3 or 4 traps, and at Model "YS-8" supply tube with combinations of Model DU-3 and DU-4 distribution units for priming from 5 to 8 traps.

.3 Electronic Primer:

.1 Precision Plumbing Products “PT Prime Time” Series, recessed or surface mount, CSA certified, 115 volt, 1 phase, 60 Hz., electronic, automatic trap priming manifolds, each sized to suit the number of drain traps or interceptors serviced, and each complete with:

.1 Cabinet:

.1 Recessed Cabinet: In finished areas provide a galvanized steel NEMA-1 cabinet complete with hinged door or cover plate.

.2 Surface Mount Cabinet: In unfinished areas (Janitor Rooms, Mechanical Rooms, etc.) provide a powder coated steel NEMA-1 cabinet complete with hinged door or cover plate.

.2 20 mm (3/4-inch) diameter NPT copper pipe inlet with shut-off valve and water hammer arrestor.

.3 A solenoid valve, an atmospheric vacuum breaker, and a discharge manifold with 12 mm (1/2-inch) diameter compression type copper tube connections on 40 mm (1-1/2 inch) centres with quantity to suit the number of items to be primed.

.4 A control panel with circuit breaker, 5 ampere fuse, 24 hour timer, and manual override toggle switch.

2.13 SHOCK ABSORBERS

.1 Type 304 stainless steel piping shock absorbers, each complete with a nesting type bellows and a casing of sufficient displacement volume to dissipate the kinetic energy generated in the piping system, and each sized to suit the connecting potable water pipe and equipment it is provided for. Acceptable products are:

.1 Zurn #Z1700 “SHOKTROL”.

.2 Precision Plumbing Products (PPP) “SS” Series.

.3 Jay R. Smith 5000 Series “HYDROTROL”.

.4 Mifab “HAMMERGUARD” WHB Series.

.5 Watts Water Technologies (Canada), Inc. SS Series.

2.14 BACKFLOW PREVENTERS

.1 Reduced pressure zone dual check valve design lead free backflow preventers in accordance with CSA B64, each of bronze or epoxy coated cast iron bronze fitted construction depending on size, and complete with inlet strainer, inlet and outlet shut-off valves, an intermediate relief valve, ball valve type test cocks, and a proper air gap fitting. Acceptable products are:

.1 Watts Water Technologies #LF009QT for 12 mm (1/2-inch) size and #LF909QT for 20 mm to 50 mm (3/4-inch to 2 inch) size.

.2 Watts Water Technologies 957 or 994 series for 65 mm to 250 mm (2-1/2 inch to 10 inch) size (stainless steel).

.3 Zurn/Wilkins #375 for 20 mm to 50 mm (3/4-inch to 2 inch) size

.4 Zurn/Wilkins #375AST series for 65 mm to 250 mm (2-1/2 inch to 10 inch) size.

.5 Conbraco Industries Inc. Series 40-200 for 12 mm to 50 mm (1/2-inch to 2 inch) size.

.6 Conbraco Industries Inc. Series 4A-200 LBF or 4AN-200LBF (stainless steel) 65 mm to 250 mm (2-1/2 inch to 10 inch) size.

.7 Ames Model LF2000B for 12 mm to 50 mm (1/2-inch to 2 inch) size.

.8 Ames Model 4000SS (stainless steel) for 65 mm to 250 mm (2-1/2 inch to 10 inch) size.

2.15 PIPING "V-LOOP" EXPANSION COMPENSATORS

.1 Piping and equipment connections shall be protected against seismic damage by the insertion of braided flexible hose.

.2 Vee assemblies shall be rated for ±4" (100mm) seismic motion in all planes. Should the application include ±6" (150mm) thermal movement or thermal movement alone, install the Vee so the thermal movement is axial.

.3 All submittals shall include a recognized test report, covering the full range of the specified movements at the operating pressures.

.4 Vees shall have a minimum burst pressure of four times their rated pressure.

.5 Vees in steel lines shall have stainless hose and braid with threaded ends, weld ends or floating flanges. In stainless lines, all fittings in contact with the media must be stainless as well. Copper lines, bronze hose and braid with copper or bronze fittings. Guiding and anchoring shall be as designed by the manufacturer, stamped by a Professional Engineer and included with the submittals.

.6 Acceptable products are:

.1 Manson Industries Inc, Vee Assembly.

.2 Hyspan Precision Products, Series 4500 V-flex.

.3 Metraflex, Metraloop V-loop.

2.16 POTABLE THERMOSTATIC MIXING VALVES

.1 Rough bronze lead free thermostatic mixing valve assemblies, each complete with ball type shut-off valves, pressure regulating valve, angle check stops, and dial type thermometer. Provide dual thermostatic mixing valves as necessary to allow for a minimum flow of 0.06 L/s (1 gpm). In finished areas mount the mixing valve in a recessed or a surface wall mounted stainless steel cabinet complete with a plexi-glass window in door. In unfinished areas (Janitor Rooms, Mechanical Rooms, etc.) no cabinet is required.

.1 Individual fixture thermostatic valves to be sized by fixture manufacturer.

.2 Acceptable manufacturers are:

.1 Leonard Valve Company.

.2 Lawler Manufacturing Co, Inc.

.3 Powers (Watts Water Technologies Company).

.4 Symmons Industries, Inc.

.5 Acorn Engineering Company.

2.17 FLEXIBLE PUMP CONNETIONS

.1 Flexible metal hose assemblies, each complete with annular corrugated unbraided type 321 stainless steel inner core, braided type 321 stainless steel hose, and a collar and flange at each end, all suitable for twice the working pressure of the system. NSF 372 Lead Free. Acceptable products are:

.1 Metraflex Company. Flexible metal hose.

.2 Thorburn Equipment Inc. corrugated metal hose

.3 Senior Flexonics Inc. A1 and A6 Series

2.18 PEX SYSTEM ACCESSORIES

.1 Fixture Shut-Off Valves: Fixture Shut-Off valves shall be supplied by the PEX tubing manufacturer.

.2 Tubing Wall Penetration Brackets: Brackets designed for tubing wall membrane penetrations shall be supplied by PEX tubing manufacturer.

2.19 PRESSURE REDUCING VALVES:

.1 For piping to and including 50 mm (2 inch) diameter, non-corrosive, non-ferrous direct spring acting pressure reducing valves to CSA B356, each factory set at 345 kPa (50 psi) unless otherwise specified or required, each field adjustable from 175 kPa to 520 kPa (25 psi to 75 psi) and each complete with an integral inlet strainer. Acceptable products are:

.1 Conbraco 36 Series.

.2 Zurn/Wilkins 600 Series.

.3 Watts Water Technologies (Canada), Inc. LF25AUB-Z3.

.4 Cash-Acme EB-86U Series.

.2 For piping 75 mm (3 inch) diameter and larger, non-corrosive pilot operated pressure reducing valve to CSA B356, factory set at the required pressure, field adjustable, and complete with a coated cast iron or ductile iron body and trim, screwed or flanged connections, and brass body pilot valve with stainless steel seat. Acceptable products are:

.1 Singer Valve Model 106 PR.

.2 Zurn/Wilkins Model ZW209.

.3 Watts Water Technologies (Canada), Inc. Model F115-150 and Model 300 (flanged), PV10M/T.

2.20 STRAINERS

.1 For pipe diameters 65 mm (2.5 inch) and below: Lead Free, Class 125, 1380 kPa (200 psi) WOG rated, certified to NSF/ANSI/CAN 61. Main body and access cover shall be bronze or copper silicon alloy. The strainer screen shall be 300 series stainless steel and available in 20 mesh. Screens shall be accessible for cleaning without removing the device from the line. Acceptable products are:

.1 Zurn/Wilkins Model SXL or YBX

.2 Watts Water Technologies Series LF777 or LFS777

.3 Mueller LF351, LF352

.2 For pipe diameters 75 mm (3 inch) and above: Lead Free, Class 125, 1380 kPa (200 psi) WOG rated, certified to NSF/ANSI/CAN 61. The main body and access cover shall be ductile iron complete with an NSF/ANSI/CAN 61 certified Fusion Epoxy Finish coating inside and out. The strainer screen shall be 300 series stainless steel and available in 20 mesh. Screens shall be accessible for cleaning without removing the device from the line. Acceptable products are:

.1 Zurn/Wilkins Model FSC

.2 Watts Water Technologies Series 77F-DI

.3 MAS W40-A-YX-FF

3 Execution

3.1 INSTALLATION OF SHUTT-OFF AND CHECK VALVES

.1 Provide shut-off valves on each branch to each piece of equipment, fixtures and wherever else indicated on Drawings.

.2 Provide check valves on pump discharge and wherever else indicated on Drawings.

3.2 INSTALLATION OF DRAIN VALVES

.1 Provide a drain valve at the bottom of potable water piping risers and at all other piping low points.

.2 Locate drain valves so that they are easily accessible.

3.3 INSTALLATION OF UTILITY WATER METER

.1 Provide the potable water service meter where shown. Secure the meter in place on a concrete housekeeping pad and connect with piping as indicated, including a three-valve bypass.

.2 Provide and install all other hardware necessary to connect to utility.

.3 Connect all meter to BAS for metering; provide all wiring and BACnet gateway.

3.4 INSTALLATION OF WATER SUB-METERS

.1 Provide potable water service meter(s) where shown on Drawings. Secure the meter in place and connect with piping as indicated, including shut off valves upstream and downstream of the meter for servicing.

.2 Connect all meters to BAS for remote metering; provide all wiring and BACnet gateways.

3.5 INSTALLATION OF AUTOMATIC FLOW LIMITING & BALANCING VALVES

.1 Provide balancing valve(s) in potable hot water recirculation piping where shown.

.2 Locate each valve such that it is easily accessible.

3.6 INSTALLATION OF HOSE BIBBS

.1 Provide hose bibs where shown and/or specified on the Drawings.

.2 Unless otherwise shown, specified or required, mount hose bibs approximately 915 mm (3 feet) above the floor. Confirm exact locations prior to roughing-in.

3.7 INSTALLATION OF EXTERIOR NON-FREEZE WALL HYDRANTS

.1 Provide non-freeze wall hydrants where shown.

.2 Install hydrants level and plumb such that hose outlets are approximately 600 mm (2 feet) above grade level. Confirm exact locations prior to roughing-in.

3.8 INSTALLATION OF HOSE REELS

.1 Reels to be shipped completely assembled, ready to install.

.2 Install in accordance with the manufacturer's published instructions and details for wall mount application.

.3 Connect incoming piping to a swivel joint with a flexible connector.

.4 Provide shock absorber at inlet side of each unit.

3.9 INSTALLATION OF VACUUM BREAKERS

.1 Provide a vacuum breaker for each potable water hose bibb that is not factory equipped with an integral vacuum breaker.

3.10 INSTALLATION OF TRAP SEAL PRIMERS

.1 Provide accessible trap seal primers to automatically maintain a water seal in floor drain traps. Install in accordance with the manufacturer's instructions and details.

.2 Connect each trap seal primer inlet with Type "L" hard copper tubing off the top of the nearest available potable water piping to plumbing fixtures or equipment.

.3 Where multiple traps (3 to 8) are to be primed by a single primer valve, provide distribution unit(s) and, where required, a supply tube. Wall mount level and plumb, and provide a clear plastic cover.

.4 In mechanical rooms, garage areas, and vestibules (remote locations) provide 115 volt, electronic, surface wall mounting trap primer assemblies for multiple traps (1 to 30) and wherever else indicated. Include for a 115 volt, 15 ampere circuit to each assembly extended from the nearest suitable panelboard and with wiring in conduit to the standards of Division 26.

.5 Above grade provide 12 mm (1/2-inch) Type "L" copper piping to each trap. Exposed piping is to be hard drawn. Concealed piping is to be soft.

.6 Below grade and concrete embedded provide 12 mm (1/2-inch) high density polyethylene tubing to each trap.

3.11 INSTALLATION OF SHOCK ABSORBERS

.1 Provide accessible shock absorbers in potable water piping at groups of plumbing fixtures, at the top of risers as required to prevent piping water hammer.

.2 Ensure that the size of each shock absorber is properly selected to suit the size of the potable water pipe and the equipment of the pipe is connected to.

.3 Install each unit in a piping tee either horizontally or vertically in the path of potential water shock in accordance with the manufacturer's published instructions and details.

3.12 INSTALLATION OF BACKFLOW PREVENTERS

.1 Provide a backflow preventer in each direct potable cold water connection to equipment other than plumbing fixtures and fittings. Equipment may be grouped (or zoned) together using a single backflow preventer if permissible by the applicable plumbing code and CSA B64.1

.2 Locate each backflow preventer such that it is easily accessible for maintenance and testing. Equip each backflow preventer with an air gap fitting and pipe the reduced pressure zone water outlet to drain.

.3 Install and test backflow preventer in accordance with CSA B64.

3.13 INSTALLATION OF PIPING "V-LOOP" EXPANSION COMPENSATORS

.1 Provide expansion compensators in potable water piping at building expansion joints and where shown on Drawings.

.2 Ensure that pipe ends are properly aligned. Provide alignment guides where shown, and anchor piping where indicated by means of anchors supplied by the expansion compensator manufacturer or by means of approved site fabricated anchors.

3.14 INSTALLATION OF THERMOSTATIC MIXING VALVES

.1 Provide a potable hot water thermostatic mixing valve assembly where shown on Drawings and wall mount.

.2 Adjust each valve to design requirements and check and test operation. Set maximum temperature limit stops.

.3 Identify each valve and its water temperature delivery setting with an engraved plate.

3.15 INSTALLATION OF PRESSURE REDUCING VALVE

.1 Provide potable water pressure reducing valves in piping where shown. Install so that each valve is readily accessible. Whenever possible, provide pressure reducing valves factory preset to required pressures.

.2 Provide a pressure gauge in accordance with Section 20 05 19 in piping at each side of each pressure reducing valve. Check and test operation and adjust as required.

3.16 INSTALLATION OF STRAINERS

.1 In lieu of integral potable water strainers, separate potable water strainers may be provided for pressure reducing valves, backflow preventers, and water meters.

.2 Provide potable water strainers wherever shown contractor documents or for equipment where sediments could cause premature failure (refer to written manufacturer installation instructions or recommendations).

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 22 08 00 – Commissioning of Plumbing

.3 Section 22 11 16 – Domestic Water Piping.

.4 Section 22 11 19 – Domestic Water Specialties.

.5 Section 22 34 36 - Domestic Hot Water Heaters and Storage Tanks

1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)

.1 ASME BPVC, Boiler & Pressure Vessel Code.

.2 National Sanitation Foundation (NSF International)

.1 NSF/ANSI 61, Drinking Water System Components – Health Effects

.2 NSF/ANSI 372, Drinking Water System Components – Lead Content

.3 National Building Code.

.4 UL508 Standard for Industrial Control Equipment.

1.3 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Product Data:

.1 Provide the manufacturer's printed product literature and datasheets for expansion tanks and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 77 00 – Closeout Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 EXPANSION TANK

.1 Application

.1 For use in closed, potable hot water systems to control pressure build-up and protect the water heater.

.2 Accepts expanded water as system temperature rises and returns hot water to system when demand occurs.

.2 Construction

.1 Shell & Liner: High strength carbon steel shell complete with antimicrobial polypropylene liner.

.2 Diaphragm: Heavy duty fixed butyl/EPDM bladder.

.3 System Connection: NPT Stainless Steel.

.4 Air Valve: Projection welded 302"-32NC charging valve and cap

.5 Finish: Red Oxide Primer, Enamel Paint, or Epoxy Paint

.6 Factory Pre-charge:

.7 In-Line Models: 3.5 bar (50 PSIG)

.8 Stand Models: 2.8 bar (40 PSIG)

.9 The tank must be constructed in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code, and listed to NSF/ANSI 61.

.3 Performance

.1 Max. Operating Temperature: 93º C (200º F)

.2 Max. Working Pressure: 10.3 bar (150 PSIG)

.4 Acceptable Manufacturers

.1 Amtrol Inc.

.2 Wessels Company.

.3 Watts Industries (Canada) Inc.

.4 Xylem Inc. (Bell & Gossett Inc.)

.5 Armstrong Fluid Technology Ltd.

.6 Taco Inc.

.7 Calefactio

3 Execution

3.1 INSTALLATION OF EXPANSION TANK

.1 Provide domestic water expansion tank upstream of domestic hot water storage on the incoming cold water line. Ensure expansion tank is downstream of the hot water check valve.

.2 Install a shut-off valve and pressure gauge on incoming line for servicing and pressure equalization.

.3 Before installation complete pre-charge equalization of the tank and incoming supply line pressure. Final air charge shall match the incoming supply pressure.

.4 Follow all manufacturer recommendations.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 22 11 16 – Domestic Water Piping.

.3 Section 22 11 19 – Domestic Water Specialties.

.4 Section 22 34 36 – Domestic Hot Water Heaters and Storage Tanks

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA)

.1 CAN/CSA 22.2 No 14, Canadian Electrical Code, Part II, Liquid Pumps.

.2 CAN/CSA 22.2 No 108, Canadian Electrical Code, Part II, Industrial Control Equipment.

.2 National Sanitation Foundation (NSF International)

.1 NSF/ANSI 61, Drinking Water System Components – Health Effects

.2 NSF/ANSI 371, Drinking Water System Components – Lead Content

.3 National Building Code (NBC)

1.3 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Product Data:

.1 Provide the manufacturer's printed product literature and datasheets for pumps including product characteristics, material selections, pump curve, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 77 00 – Closeout Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 POTABLE HOT WATER CIRCULATING PUMPS

.1 Provide horizontal, in-line type, centrifugal bronze or stainless steel pump in accordance with Domestic Water Pump Schedule, and this specification complete with:

.1 A dynamically balanced closed type Polyether Imide (PEI) impeller fitted to a stainless steel shaft and equipped with oil submerged double bronze bearings and thrust collar.

.2 A water-tight mechanical seal.

.3 A resiliently mounted motor in accordance with Section 20 05 00, connected to the pump shaft by means of a single spring flexible coupling with guard.

.4 Starter

.5 Provide BAS interface, refer to control DWGs and specifications for requirements

.2 Pump shall be suitable for use in potable water systems and complete with NSF-61/NSF-372 certifications.

.3 Acceptable Manufacturers

.1 Armstrong Fluid Technology Ltd.

.2 Bell & Gossett Inc. (Xylem Inc.)

.3 Grundfos Canada Inc.

2.2 POTABLE COLD WATER PRESSURE BOOSTER PUMPS

.1 General:

.1 Provide a pressure booster system in accordance with the Domestic Water Pump Schedule and this specification based on a suction pressure of between 103 kPa (15 psig) and 276 kPa (40 psig), final suction pressure to selected by the contractor and shall be based on the site fire-hydrant flow test performed under Specification 21 13 13. The maximum working pressure of the package shall be 370.0 psi.

.2 Each pump shall be factory assembled complete with VFD & pressure reducing valve. Pump service shall be accomplished without disturbing the suction and discharge piping.

.3 Pump system shall be supplied with manifold mounted liquid filled pressure gauges for indicating suction and discharge pressure.

.4 Package Vertical MultiStage (VMS) pump, with pump characteristics which provide rising heads to shut off, shall be supplied with a TEFC, NEMA Premium efficiency motor and a Type-12 enclosure variable speed drive, which shall be integrated with the motor. Drives shall not be enclosed within the control panel.

.5 Variable frequency drives shall have the following features: VVC-PWM type providing near unity displacement power factor (cos ø) without the need for external power factor correction capacitors at all loads and speeds, DC link chokes for the reduction of mains borne harmonic currents to reduce the DC link ripple current thereby increasing the DC link capacitors lifetime, UL and C-UL Listed and CE Marked showing compliance with both the EMC directive 89/336/EEC and the Low Voltage directive 72/23/EEC, RFI filters incorporated within the drive to ensure it meets the emission and immunity requirements of EN61800-3 to the 1st Environment Class C1 (EN55011 unrestricted sales class B), VFD and motor protection shall include: motor phase to phase fault, motor phase to earth fault, loss of supply phase, over voltage, under voltage, motor over temperature, inverter overload, over current.

.6 Pump shall be suitable for use in potable water systems and complete with NSF-61/NSF-372 certifications.

.2 Construction:

.1 Factory Prefabrication: The system shall be factory prefabricated with a stainless steel base and panel support, including ball isolation valves on the suction and discharge of each pump, silent check valves on the discharge as well as stainless steel headers with threaded, grooved, or flanged system connections. All interconnecting piping shall be stainless steel. The only field connections required shall be piping to the system headers and one incoming power connection at the control panel.

.2 Pump Casing: 304 Stainless Steel with ANSI-250 flanges.

.3 Impeller: Stainless Steel, fully enclosed type.

.4 Shaft: Stainless Steel pump shaft.

.5 Coupling: Rigid spacer type of Brass or Steel. Coupling to be designed to allow removal of all mechanical seal components for servicing without removal of the pump.

.6 Mechanical Seals: Mechanical shaft seal with FPM® secondary seal, carbon rotating face and silicon carbide stationary seat.

.3 Control Panel:

.1 The control panel shall be of the programmable logic controller (PLC) type. The complete control panel assembly and all internal devices shall be UL508 and/or CSA 22.2 No 14 labeled. The panel shall be complete with NEMA Type 12 Painted Steel Enclosure (STD) and include door interlocked main disconnect, water tight, LCD interface, fused drive connections, adjustable time delays, Hand-Off-Auto selector for each pump and minimum run timers. The control circuit shall include fault relay circuit to turn on the next pump should the lead pump fail.

.2 The controller must be capable of controlling all pumps, with a 4-20 mA analogue signal using pressure as the control variable. Controller design shall include provisions for low flow energy savings, soft fill mode, pressure set-back mode, emergency power mode, best-operating-point (BOP) sequencing, end of pump curve protection, 24hr operation automatic alternation of pumps, built-in pump on-delay and minimum run timers, re-settable pump elapsed run time meters, smooth pump starting and sequencing, on-screen field modifiable control and alarm parameters, option for alphanumeric or color graphic touchscreen display, high suction pressure shutdown and no-flow shutdown with drawdown tank/system optimization.

.3 On-screen alarm display with alarm identification shall be incorporated with the following alarms included: low and high system pressure shutdown, low suction pressure or level shutdown, pump failure drive fault, and suction and discharge pressure sensor failures. The controller shall include on-screen fault description and possible cause information with alarm horn for alarms.

.4 Non-volatile factory set parameters must be capable of being restored at any time in the field without requiring any programming device or connection to an external source. The controller must hold software in FLASH memory storage which prevents accidental loss of data due to voltage surge or spike.

.5 All controls to be factory pre-wired and tested in accordance with provisions of the national electrical code. All control wires shall be individually numbered and each component shall be labeled accordingly. All internal wiring shall be Copper stranded, A.W.G. with a minimum 90°F rating. The controller shall bear the UL508 and/or CSA 22.2 No 14 label for industrial controls. Serial Communications Port complete with BacNet (MS/TP) protocol included.

.6 Provide BAS interface, refer to control DWGs and specifications for requirements.

.4 Acceptable Manufacturers

.1 Grundfos Canada Inc.

.2 Armstrong Fluid Technology Ltd.

.3 Xylem Inc. (Bell & Gossett Inc.)

.4 Taco Inc.

3 Execution

3.1 INSTALLATION OF POTABLE HOT WATER CIRCULATING PUMPS

.1 Provide domestic hot water circulating pumps where shown in the Drawings.

.2 Install pump(s) in vertical piping approximately 1200 mm (4 feet) above the floor. Provide a shut-off valve in both suction and discharge piping connections, and a check valve in pump discharge piping.

.3 Controls:

.1 Control the pump to switch ON/OFF based on the return water temperature. ON/OFF control shall be user adjustable between 79°C (120°F) and 38°C (100°F) and/or

.2 Refer to BAS interface; refer to control DWGs and specifications for control requirements.

.4 When installation is complete but prior to start-up, recheck the assembly, including all control and safety functions to ensure that the set is ready for start-up. Start-up the set in accordance with the manufacturer's published instructions and make any required final adjustments. Test and commission according to performance requirements and sequence of operation, BAS interface, etc.

3.2 INSTALLATION OF POTABLE COLD WATER PRESSURE BOOSTER PUMPS

.1 Provide a packaged type domestic cold water pressure booster pump set where shown in the Drawings.

.2 Mount the assembly on a concrete housekeeping pad, shim the unit level such that suction and discharge headers are vertical, and secure in place.

.3 Support suction and discharge piping connections independent of the pump set assembly.

.4 When installation is complete but prior to start-up, recheck the assembly, including all control and safety functions to ensure that the set is ready for start-up. Start-up the set in accordance with the manufacturer's published instructions and make any required final adjustments.

.5 Controls:

.1 Pump Sequencing: The pump designated as the lead pump shall start following a 5 second On-Delay time after sensing a drop in the system pressure 5 PSI below the desired set point value. The pump controller shall compare a signal from the discharge pressure transducer to the set point value and the lead pump speed shall ramp up in order to satisfy the set point pressure. The lag pump shall start following a 60 second On-Delay time, when the lead pump exceeds its best operating point (BOP), and a minimum run timer shall ensure that the lag pump runs for a minimum of 60 seconds. The lag pump shall ramp down in speed and turn off when the pumps that are running are operating at a point below the BOP and the lag pump minimum run timer has expired. The lead pump shall continue to operate and meet system requirements based on the set point value. The lead pump shall alternate every 24 hrs of operation where the second pump shall start and run for a period of 5 seconds, both pumps shall operate, the first pump on shall ramp down and the new lead pump shall continue to operate as above to meet system requirement.

.2 Lead Pump Shutdown Controls: All systems are equipped with a "No-Flow" shutdown that will stop the pumps when the pump controller determines there has been a "No-Flow" condition for a continuous 5-min. The lead pump will start again once a drop in pressure of at least 5 psi is measured on the discharge of the system. The system can be manually operated by means of the virtual Hand-off-Auto (HOA) selector buttons provided on the operator interface.

.3 Refer to BAS interface; refer to control DWGs and specifications for control requirements.

.6 When installation is complete but prior to start-up, recheck the assembly, including all control and safety functions to ensure that the set is ready for start-up. Start-up the set in accordance with the manufacturer's published instructions and make any required final adjustments. Test and commission according to performance requirements and sequence of operation, BAS interface, etc.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 22 13 29 – Sump Pumps and Pits

.3 Section 22 42 00 – Plumbing Fixtures.

.4 Section 01 81 19 – LEED Indoor Air Quality Requirements

.5 Civil Division

1.2 REFERENCE STANDARDS

.1 ASTM International Inc.

.1 ASTM B306, Standard Specification for Copper Drainage Tube (DWV).

.2 American Water Works Association (AWWA)

.1 ANSI/AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast

.2 ANSI/AWWA C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

.3 ANSI/AWWA C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems

.4 ANSI/AWWA C110/A21.10, Ductile-Iron and Gray-Iron Fittings

.5 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA B70, Cast iron soil pipe, fittings, and means of joining.

.2 CAN/CSA B602, Mechanical couplings for drain, waste, and vent and sewer pipe.

.3 CAN/CSA B182.2, PSM Type Polyvinylchloride (PVC) Sewer Pipe and Fittings.

.4 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC S102.2, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 ULC/CAN4-S115-M85 Standard Method of Fire Tests of Firestop Systems

.5 Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

.1 Material Safety Data Sheets (MSDS).

.6 National Building Code 2020 (NBC)

1.3 SUBMITALS

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings:

.1 Submit shop drawings for all products specified in this Section except pipe and fittings. Shop drawings are to include all components including but not limited to panel layout drawings, wiring diagrams with wire numbers, individual components within panel, motor shop drawing, etc.

.2 Contractor shall provide vent piping in accordance with NBC/NPC and local bylaws. Submit plumbing vent piping sizing/ calculations and vent piping layout drawings shop drawings for all buildings. Shop drawings are to include all components including but not limited to layout drawings, vent terminations, installation details.

.3 Test Data: Submit the following test data prior to application for Substantial Performance of the Work.

.1 Pipe leakage test sheets in accordance with Section 20 05 00 – General Mechanical Requirements.

.2 A copy of the plumbing inspection certificate.

.3 Any other start-up or test data specified in this Section.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 – Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 PIPE, FITTINGS AND JOINTS

.1 Adhesives and Sealants: Use sealants in compliance with Section 01 81 19 – LEED Indoor Air Quality Requirements, as recommended by the Manufacturer, in accordance with Section 01 60 00 – Product Requirements as well as relevant ASTM standards.

2.2 PIPING AND FITTINGS

.1 Solvent Weld PVC Sewer Pipe: SDR 35, 100 mm (4") and below, rigid PVC hub and spigot pattern sewer pipe and fittings in accordance with CAN/CSA B182.2. Solvent weld cement and primer (when required by manufacture) shall be same manufacturer as pipe.

.1 Acceptable Manufacturers

.1 Ipex Solvent Weld Sewer Pipe (Formerly Canron and Scepter, sister company Canplas)

.2 NAPCO BDS Solvent Weld Pipe (Formerly North American Pipe Corporation and Royal Pipe & Fittings)

.2 Gasketed PVC Sewer Pipe: SDR 35, 100 mm (4") and above, rigid PVC hub and spigot pattern sewer pipe and fittings in accordance with CAN/CSA B182.2, with gasket joints assembled with pipe lubricant from same manufacture as pipe.

.1 Acceptable Manufacturers

.1 Ipex “Ring-Tite” Sewer Pipe (Formerly Canron and Scepter, sister company Canplas)

.2 NAPCO Gasketed Sewer Pipe SDR 35/26 (Formerly North American Pipe Corporation and Royal Pipe & Fittings)

.3 Next Polymers “Duraloc” Sewer Pipe

.3 PVC DWV Pipe: Ipex Inc. System 15 rigid PVC drain, waste, and vent pipe and fittings manufactured to CAN/CSA B181.2, complete with solvent weld joints. Solvent weld cement and primer (when required by manufacture) shall be same manufacturer as pipe. When used in buildings of non-combustible construction all PVC pipes shall be certified to CAN/ULC S102.2 and achieve a Flame Spread Rating not exceeding 25. System 15 shall not be used in high buildings or air plenums. For dry fire barrier penetration, an approved firestop conforming to the requirements of ULC/CAN S115-M95 shall be installed at all fire rated walls.

.1 Acceptable Manufacturers

.1 Ipex “System 15” DWV Pipe (Formerly Canron and Scepter, sister company Canplas)

.2 NAPCO NAPSYS™ - LR PVC DWV 25 Pipe (Formerly North American Pipe Corporation and Royal Pipe & Fittings)

.4 Plenum Rated PVC DWV Pipe: Ipex Inc. System XFR rigid PVC drain, waste, and vent pipe and fittings to CAN/CSA B181.2, complete with solvent weld joints. Solvent weld cement and primer (when required by manufacture) shall be same manufacturer as pipe. When used in buildings of non-combustible construction, high buildings, and air plenums all PVC pipes shall be certified to CAN/ULC S102.2, achieve a Flame Spread Rating not exceeding 25 and achieve Smoke Developed Classification not exceeding 50. For dry fire barrier penetration, an approved firestop conforming to the requirements of ULC/CAN S115-M95 shall be installed at all fire rated walls.

.1 Acceptable Manufacturers

.1 Ipex “XFR” DWV Pipe (Formerly Canron and Scepter, sister company Canplas)

.2 NAPCO NAPSYS™ - HR PVC DWV 25/50 Pipe (Formerly North American Pipe Corporation and Royal Pipe & Fittings)

.5 DWV Copper - Solder Joint: Type DWV hard temper in accordance with ASTM B306, complete with wrought copper solder type drainage fittings, ANSI/ASME B16.29 or cast copper solder type drainage fittings, ANSI/ASME B16.23. Soldered joints made using 96-0.5-4 tin silver copper, 95-5 tin antimony, 96-6 tin silver, or 96-4 tin silver solder, conforming to ASTM B32.

.6 Cast Iron: Cast iron pipe, fittings and joints in accordance with CAN/CSA B70, couplings to CAN/CSA B602 (Class 4000).

.7 Ductile Iron: Centrifugally cast ductile iron to ANSI/AWWA C151/A21.51 complete with ANSI/AWWA C104/A21.4 cement lining, and ANSI/AWWA C105/A21.5 protective polyethylene film (minimum nominal thickness of 200 microns and minus tolerance with 10 percent). Fittings to be cement lined ductile-iron/cast-iron mechanical joint fittings to ANSI/AWWA C110/A21.10. Rubber gasket joints for cast-iron or ductile-iron water pipes shall conform to ANSI/AWWA C110/A21.11.

.8 DWV Copper-Grooved Coupling Joint: Type DWV hard temper in accordance with ASTM B306, with factory or site rolled grooved ends (with grooving rolls designed for copper) and Victaulic Co. "Copper Connection" wrought copper or cast bronze fittings and Style 606 gasket type couplings or Grinnell (Tyco Mechanical Products) Style 672.

.9 Radon soil gas venting, Schedule 40 PVC piping system that addresses the need for venting soil gases. – Radon PVC pipes and fittings shall be manufactured from compounds that comply with the material requirements of CSA B181.2 “PVC Drain, Waste and Vent Pipe and Pipe Fittings”. Radon pipe and fittings must comply to all material and testing requirements of CSA B181.2 and ASTM D2665. Radon piping system must comply to gas leakage, pull out, torque and combustibility test requirements of ULC S636. Radon vent pipe and fittings shall be listed by ULC to the standard CAN/ULC S102.2 and clearly marked with the certification logo indicating a Flame Spread Rating not exceeding 25. Radon pipe and fittings shall be 100mm (4 in.) Schedule 40 size and meet the dimensional requirements of CSA B181.2 and ASTM D2665.

.10 Subsoil drainage: corrugated high density polyethylene tubing used in sub-drainage applications. Pipe shall be manufactured from good quality high density polyethylene resin. The pipes shall be joined with external ‘insert’ or ‘split’ couplers. The tube shall have a minimum stiffness of 210 kPa at 5% deflection. Tests shall be conducted in accordance with ASTM D2412.

3 Execution

3.1 UNDERGROUND MUNICIPAL SERVICE CONNECTION

.1 All underground sanitary and storm sewers outside the building footprint (1.5 m from the outside of the foundation wall to the property line) shall be covered by the Civil Division.

3.2 PIPING INSTALLATION REQUIREMENTS

.1 Provide all required drainage, waste, and vent piping. Pipe, unless otherwise specified in the Contract Documents, shall be as follows:

.1 For underground sanitary and storm pipe inside the building footprint use rigid PVC Sewer Pipe, minimum 100 mm (4") diameter.

.1 For pipe sizes 150 mm (6") diameter and smaller use Solvent Weld PVC Sewer Pipe, for all larger pipe diameters use Gasketed PVC Sewer Pipe installed in accordance with National Plumbing Code and manufacturer installation requirements and recommendations.

.2 Where permitted by the NBC, Ductile Iron or Cast Iron may be used in lieu of PVC DWV Pipe .

.2 For sanitary and storm pipe inside the building and above ground in sizes up to and including 65 mm (2½") diameter type DWV Copper shall be used. Where permitted by the NBC, PVC DWV Pipe may be used in lieu of DWV Copper.

.3 For sanitary and storm pipe inside the building and above ground in sizes 75 mm (3") diameter and larger - Cast Iron shall be used except for drainage pump discharge pipe. Where permitted by the NBC, PVC DWV Pipe may be used in lieu of Cast Iron.

.4 For storm pipe outside the building and above ground, stainless steel or other steel pipe coated for saline environment shall be used. All pipes exposed shall be zinc plated unless otherwise noted. All pipes exposed to the environment or located in corrosive or humid indoor environment, shall be constructed from corrosion resistant materials e.g. Stainless Steel 316 or fiberglass. Submit shop drawings and layouts depicting the various hangers’ materials.

.5 For sanitary and storm pump discharge piping, refer to Section 22 13 29 – Sump Pumps & Pits.

.6 In high buildings or air plenums Plenum Rated PVC DWV Pipe shall be used in lieu of PVC DWV Pipe.

.7 Radon pipe and fittings must be tested as a system by IPEX Inc. Mixing of pipe, fittings or joining methods from different manufacturers is not allowed as they have different joint systems and adhesives. Radon pipe and fittings must NOT be used for any applications other than soil gas venting. For subsoil drainage piping,

.1 Tubing shall be bedded in gravel or crushed stone however, selected soil backfill material may also be used with satisfactory results. The top and sides of the drain pipe or tile shall be covered with not less than 150mm of crushed stone or other coarse clean granular material. When selected soil bedding material from the trench excavation is used, choose small loose particles of soil that will flow around the tubing and minimize soil settling. Avoid large rocks that may damage the tubing or large clods of soil that cause voids and subsequent excessive settling.

.2 For areas where tubing is exposed to vehicular traffic, there should be a minimum of 30cm (12") of cover over the tubing if gravel bedding material is used and 61cm (24") of cover if selected soil bedding material is used. Typical recommended gravel materials are pea gravel, granular A stone or pit run course sand and gravel mixes.

.3 Achieve a continuous downhill fall, or grade, over the entire length of the drain line. A fall of 5cm (2") per 30m (100') of length is generally considered adequate.

.4 Backfill

.2 Lay pipes true to line and grade with bells upgrade. Fit sections together so that, when complete, the pipe has a smooth and uniform invert. Keep pipe thoroughly clean so that jointed compound will adhere. Inspect the pipe for defects before lowering the pipe into the trench. Do not use defective pipe.

.3 The following publications shall be used to establish class of bedding and class of piping for installation other than the above. They shall also serve as guide for preparation of bedding, installation and testing.

.1 Cast iron soil pipe and fittings handbook of the cast iron soil pipe institute.

.2 Sewer Design & Construction of the Water Pollution Control Federation.

.3 The Blue Brute and Ring Tite PVC gravity sewer pipe installation Guide by Johns-Manville.

.4 Unless otherwise specified in the Contract Documents, slope horizontal drainage piping above ground in sizes to and including 75 mm (3") diameter 25 mm (1") in 1.2 m (4'), and pipe 100 mm (4") diameter and larger 25 mm (1") in 2.4 m (8').

.5 Install and slope underground drainage piping to inverts or slopes indicated on the Drawings to facilitate straight and true gradients between the points shown. Verify available slopes before installing the pipes.

.6 Unless otherwise specified in the Contract Documents, slope horizontal branches of vent piping down to the fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 (4').

.7 Extend vent stacks up through the roof generally where shown but with exact locations to suit site conditions. Terminate vent stacks 457 mm (18") above the roof in vent stack covers.

.8 Provide proper dielectric unions at connections between copper pipe and ferrous pipe or equipment.

.9 Piping and fittings installed throughout the project shall be as uniform as commercially practicable, contractor is responsible to ensure proper joints are made between pipe and fittings of different materials/manufacturers.

3.3 PIPE PRESSURE TESTING:

.1 Refer to Section 20 05 00 – General Mechanical Requirements, for test pressure for drainage and venting systems.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 22 13 16 – Drainage, Waste, and Vent Piping.

.3 Section 22 13 20 – Floor Drains.

.4 Section 22 13 23 – Oil and Sediment Waste Interceptors.

.5 Section 22 13 29 – Sump Pumps and Pits.

1.2 REFERENCE STANDARDS

.1 ASTM International Inc.

.1 ASTM A743, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

.2 ASTM A48, Standard Specification for Gray Iron Castings.

.3 ASTM A563, Standard Specification for Ductile Iron Castings.

.4 ASTM B584, ASTM Specification for Copper Alloy Sand Castings.

.5 ASTM C 1173, Standard specification for flexible transition couplings for underground piping systems

.2 American Society of Mechanical Engineers (ASME)

.1 ASME B1.20.1, Pipe Threads, General Purpose, Inch

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA B602, Mechanical couplings for drain, waste, and vent and sewer pipe.

.2 CAN/CSA B182.2, PSM Type Polyvinylchloride (PVC) Sewer Pipe and Fittings.

.3 CSA B272-93, Prefabricated Self-Sealing Roof Vent Flashings

.4 CAN/CSA-B602, Mechanical Couplings for Drain, Waste, and Vent Pipe and Sewer

.5 Pipe.

.4 National Building Code (NBC)

.5 Underwriter's Laboratories (UL)

.1 UL 2043, Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

1.3 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings: Submit shop drawings for all products specified in this Section except pipe and fittings. Shop drawings are to include all components including but not limited to panel layout drawings, wiring diagrams with wire numbers, individual components within panel, motor shop drawing, etc.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 – Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 SHUT-OFF VALVES AND CHECK VALVES

.1 Shut-off Valves: Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass or bronze body, blowout-proof stem, chrome plated brass ball, solder or screwed ends as required, and removable lever handle. Where piping is insulated provide stem extensions to clear insulation. Acceptable products are:

.1 Kitz Corporation Code 58 or Code 59

.2 Toyo Valve Co. Fig. 5049A or Fig. 5044A

.3 M.A. Steward & Sons Ltd. MAS B-3 or MAS B-4

.4 Nibco inc. #SFP-600 or TFP-600 (Brass)

.5 Nibco Inc. #S-585-70 or T-585-70 (Bronze)

.6 Victaulic Co. of Canada Ltd. Series 722

.7 Anvil International Inc. Fig. 171N

.8 Watts Water Technologies (Canada) Inc. #FBV-3 or FBVS-3

.2 Ball Check Valves: ASTM A48 Class 30, epoxy coated cast iron, minimum 1725 kPa (100 psi) WOG rated ball check valve with screwed ends, for horizontal and vertical piping. Check valve to be designed specifically for storm and wastewater applications. Self-cleaning, natural rubber or nitrile (Buna-N) ball, weighted depending on application. Acceptable products are:

.1 Flowmatic Model 208 or 508

.2 AVK Group PN 10 Variant 53/30-005

.3 Crane Company, Barnes Ball Check Valve

2.2 VENT STACK COVERS

.1 Thaler Metal Industries Ltd. Model SJ-27 (or approved equivalent), 304 stainless steel, 0.79 mm (22 ga), insulated, 457 mm (18") high vent stack covers with factory applied asphalt primer coating on the top and bottom of the flange or approved equivalent. To CSA B272-93; with removable cap, pre-molded urethane insulation liner, and EPDM Base Seal.

2.3 CLEANOUTS

.1 Horizontal Piping:

.1 Indoor: TY pipe fitting with an extra heavy brass plug screwed into the fitting.

.2 Outdoor: Extra Heavy Duty cleanout for outdoor application designed to handle safe livel of 4500 kg in accordance with ASME A112.21.1M, stainless steel top, body and plug, vandal proof top. Watts Water Technologies (Canada) Inc. #CO-1200-RX-6-28 or equivalent from Zurn, Jay R. Smith, and Mifab.

.2 Vertical Piping:

.1 Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, epoxy coated cast iron cleanout tees, each gas and water-tight, complete with an ABS tapered thread plug. Acceptable cast iron cleanout tees are:

.1 Zurn #Z-1445

.2 Jay R. Smith #4510

.3 Mifab #C1460

.4 Watts Water Technologies (Canada) Inc. #CO-460

.2 Heavy Duty Cleanout with polished stainless steel top.

.1 Zurn #ZS-1400-BZ1

.2 Acceptable alternates from Jay R. Smith, Mifab or Watts Water Technologies (Canada) Inc.

.3 Urinal(s): Wall access cleanout assemblies, each complete with a tapered plug, threaded brass insert, urethane rubber seal, and polished stainless steel access cover with vandalproof stainless steel securing screw. Acceptable products are:

.1 Zurn #Z-1666-1-VP

.2 Jay R. Smith #SQ4-1819

.3 Mifab #C1440-RD-6

.4 Watts Water Technologies (Canada) Inc. #CO-440-RD-6

2.4 FLOOR CLEANOUT TERMINATIONS

.1 Baked epoxy coated cast iron terminations, each complete with a solid stainless steel gasketed access cover to suit the floor finish, a cleanout plug, and captive stainless steel securing hardware. Acceptable products are:

.1 Zurn #ZS-1602-SP Series

.2 Jay R. Smith #4020-SS-F-C Series

.3 Mifab #C1000-R-3-34

.4 Watts Water Technologies (Canada) Inc. #CO-1200-R-3-34

.2 All cleanout terminations in areas with a tile or sheet vinyl finish are to be as above but with a square top in lieu of a round top. Refer to the Room Finish Schedule.

2.5 BACKWATER VALVES

.1 Heat bonded powder epoxy coated cast iron in-line type, each complete with a bolted and gasketed cover, bronze flapper, extension, and stainless steel hardware. Acceptable products are:

.1 Zurn Industries LLC #Z-1095-15J

.2 Jay R. Smith MFG Co. #7022

.3 Mifab Inc. #BV1200R

.4 Watts Water Technologies (Canada) Inc. #BV-230-R

2.6 BACKWATER VALVES WITH ACCESS CHAMBER AND COVERS

.1 Heat bonded powder epoxy coated cast iron in-line type, each complete with a bolted and gasketed cover, bronze flapper, and stainless steel hardware, coated steel access chamber with anchor flange, heavy duty checker plate steel secured access cover. Acceptable products are:

.1 Zurn Industries LLC #Z-1095-HOCAH-K

.2 Jay R. Smith #SQ-7-3311/7012

.3 Mifab Inc. #BV-1000 c/w BV-1280

.4 Watts Water Technologies (Canada) Inc. #BV-240

2.7 BACKWATER VALVES – FLAPPER TYPE

.1 Heat bonded powder epoxy coated cast iron body with hub inlet and open outlet for installation at end of drainage line, bronze flapper, type, each complete with a bolted and gasketed cover, bronze flapper, stainless steel hardware. Acceptable products are:

.1 Zurn Industries Inc. #Z-1091-BV

.2 Jay R. Smith MFG Co. #7070C

.3 Mifab Inc. #BV1280

.4 Watts Water Technologies (Canada) Inc. # BV-200-½

2.8 BOTTOM OUTLET FLOOR DRAIN BACKWATER VALVES – BALL TYPE

.1 Heat bonded powder epoxy coated cast iron body, complete with plastic ball float, removable bronze backwater bushing (ring), and replaceable neoprene seat. Designed to be installed directly under various floor drain bodies to prevent damaging backflow from entering room and sized to match floor drain outlet. Acceptable products are.

.1 Zurn Industries Inc. #Z-1099

.2 Jay R. Smith MFG Co. #7080

.3 Mifab Inc. #BV1260

.4 Watts Water Technologies (Canada) Inc. # BV-300

2.9 PIPING SEISMIC / EXPANSION COMPENSATORS (ABOVE GRADE)

.1 Piping at seismic expansion joints shall be protected against damage via the insertion of braided flexible hose assemblies, bellows expansion joints, or PVC flexible expansion joints. Bellows expansion joints to be used in locations with spacing limitations.

.2 Seismic/Expansion compensators shall be rated for the same axial/lateral motion as the building expansion joints (as noted in the Architectural/Structural drawings), or where not noted for a minimum of ±2” (50mm) of lateral motion in all planes and ±2” (50mm) of axial motion. Seismic/Expansion compensators located outdoors shall be rated for temperatures between -20C to 40C (-4F to 104F), and UV resistant (if exposed to sunlight).

.3 All submittals shall include a recognized test report, covering the full range of the specified movements at the operating pressures.

.4 Seismic/Expansion compensators in drainage lines shall be rated for a minimum operating pressure of 103 kPa (15 psi) and be constructed of PVC or 300 series stainless steel with solvent weld, grooved ends, and/or to suit application. Guiding and anchoring (based off expected forces) shall be as designed by the manufacturer and included with the submittals.

.5 Acceptable manufactures are:

.1 Metraflex Company.

.2 Senior Flexonics

.3 Manson Industries Inc.

.4 Hyspan Precision Products.

.5 Flexicraft Industries.

.6 EBAA Iron Inc, DWV FLEX-TEND.

2.10 PIPING SEISMIC / EXPANSION COMPENSATORS (BELOW GRADE)

.1 Flexible expansion joints shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and/or ANSI/AWWA C153/A21.53 and suitable for installation on

ductile iron, carbon steel, or PVC pipes. All fasteners shall be Type 304 Stainless Steel. Product shall be suitable for direct burial and for use with wastewater systems (storm/sanitary) per local code requirements.

.2 Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 2410 kPa (350 psi) on pipe sizes 75 mm (3 in.) to 600 mm (24 in) and 1720 kPa (250 psi) on pipe sizes 750 mm (30 in.) and larger. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply.

.3 Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having 4-inches minimum expansion and a minimum per ball deflection of:

.1 20 degrees for pipe sizes 75 mm (3 in.) to 250mm (10in.)

.2 15 degrees for pipe sizes 300 mm (12 in.) to 750mm (30 in.)

.3 12 degrees for pipe sizes 900 mm (36 in.) to 1200 mm (48 in)

.4 Additional expansion sleeves shall be available and easily added or removed at the factory or in the field. Both standardized mechanical joint and flange end connections shall be available.

.5 All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.

.6 Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

.7 Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be provided for direct buried applications.

.8 Manufacturer's certification of compliance to the above standards and requirements shall be readily available upon request. Acceptable manufactures are:

.1 FLEX-TEND c/w flanged joint, Series 2000PV MEGALUG, or Series 1100 MEGALUG (as required), by EBAA Iron Inc.

.2 StarFlex Series 5000, by Star Pipe Products.

2.11 TRANSITION COUPLING

.1 Adaptors, connector, or mechanical joints used to join dissimilar material shall be designed to accommodate the required transition.

.2 All mechanical couplings shall conform to CSA B602.

.3 Couplings used in direct burial applications shall be designed for resistance against heavy earth and shear forces and conform to ASTM C 1173 in additional to CSA B602, all banding and shielding shall be constructed of 316 stainless steel.

2.12 CONDENSATE PUMPS

.1 Condensate pumps shall be plenum rated; constructed with materials that have been tested and meet UL 2043.

.2 Pumps to be complete with built-in check valve and capable of a flow rate of 144 L/hr (38 USgal/hr) at 3.66 m (12 ft.) of head; with a maximum lift of 5.5m (18 ft.)

.3 Pump shall be controlled by a float switch mechanism, which automatically starts and stops the pump. Pumps shall also be complete with a high-water level switch, and wired to either stop the production of condensate or operate an external alarm or relay.

.4 Each pump shall be CSA or cUL certified and complete with their own hardwired 115 V or 230 V electrical connection.

.5 Acceptable Manufacturers:

.1 Hartell (Ingersoll Rand)

.2 Little Giant (Franklin Electric Co.)

3 Execution

3.1 INSTALLATION OF SHUT-OFF AND CHECK VALVES

.1 Provide shut off valves on pump discharge and wherever else indicated on the drawings.

.2 Provide check valves on pump discharge and wherever else indicated on the drawings.

3.2 SUPPLY OF VENT STACK COVERS

.1 Supply a properly sized vent stack cover for each vent stack penetrating the roof.

.2 Hand the vent stack covers to the roofing Contractor at the site for installation and flashing into roof construction as part of the roofing work. Coordinate the installation with the roofing Subcontractor to ensure proper locations. Provide waterproofing caps over vent stacks.

3.3 INSTALLATION OF CLEANOUTS

.1 Provide cleanouts in drainage piping in locations as follows:

.1 In the building drain or drains as close as possible to the inner face of the outside wall, and, if a building trap is installed, locate the cleanout on the downstream side of the building trap.

.2 At or as close as practicable to the foot of each drainage stack.

.3 At maximum 15 m (50 foot) intervals in horizontal pipe 100 mm (4 inch) diameter and smaller.

.4 At maximum 30 m (100 foot) intervals in horizontal pipe larger than 100 mm (4 inch) diameter.

.5 In the wall at each new urinal or bank of urinals in a washroom.

.6 Wherever else shown on the Drawings.

.2 Cleanouts are to be the same diameter as the pipe in piping to 100 mm (4 inch) diameter, and not less than 100 mm (4 inch) diameter in piping larger than 100 mm (4 inch) diameter.

.3 Cleanouts in vertical piping are to be cleanout tees, cast iron in piping 75 mm (3 inch) diameter and larger, copper or bronze in piping smaller than 75 mm (3 inch) dia.

.1 In locations with Heavy Duty vertical loads (>2500 lbs), heavy duty cleanouts shall be used.

.4 Cleanouts in horizontal piping are to be TY fittings with removable plugs.

.5 Where cleanouts are concealed behind walls or partitions, install the cleanouts near the floor and so that the cover is within 25 mm (1 inch) of the finished face of the wall or partition.

3.4 INSTALLATION OF FLOOR CLEANOUT TERMINATIONS

.1 Where cleanouts occur in horizontal inaccessible underground piping, extend the cleanout TY fitting up to the floor and provide a cleanout termination set flush with the finished floor.

.2 In waterproof floors, ensure that each cleanout termination is equipped with a flashing clamp device. Cleanout terminations are to suit the floor finish. Refer to Room Finish Schedules.

.3 Where cleanout terminations occur in finished areas, confirm locations prior to rough-in and arrange piping to suit.

3.5 INSTALLATION OF BACKWATER VALVES

.1 Provide backwater valve(s) in drainage piping where shown on the Drawings and connect with piping as indicated on the Drawings.

.2 Set the backwater valve assembly such that the cover is flush with the finished floor. Provide an extension piece if required due to the depth of the piping.

3.6 INSTALLATION OF SEISMIC / EXPANSION COMPENSATORS

.1 Provide expansion compensators in drainage piping at building expansion joints and where shown on Drawings.

.2 Ensure that pipe ends are properly aligned. Provide alignment guides as required, and anchor piping where indicated by means of anchors supplied by the expansion compensator manufacturer or by means of approved site fabricated anchors.

.3 When installed in a gravity drainage system the expansion joint shall be installed in such a manner that if downward deflection were to occur on the pipe upstream (inlet) of expansion joint shall, the pipe downstream (outlet) of the expansion joint shall still be maintained at a lower elevation.

3.7 INSTALLATION OF CONDENSATE PUMPS

.1 Provide condensate pumps for all air conditioning, refrigeration, and dehumidification equipment where gravity drainage is not possible or practical; or wherever else indicated on drawings.

.2 Condensate pumps shall be low-profile where required to fit into ceiling areas with limited space; or as indicated on drawings.

.3 Install as per manufacturers written instructions, coordinate final electrical connections with all trades.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Requirements.

.2 Section 22 13 16 – Drainage, Waste, and Vent Piping.

.3 Section 22 13 19 – Drainage, Waste, and Vent Piping Specialties.

1.2 REFERENCE STANDARDS

.1 ASTM International Inc.

.1 ASTM A743, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

.2 ASTM A48, Standard Specification for Gray Iron Castings.

.3 ASTM A563, Standard Specification for Ductile Iron Castings.

.4 ASTM B584, ASTM Specification for Copper Alloy Sand Castings.

.2 American Society of Mechanical Engineers (ASME)

.1 ASME B1.20.1, Pipe Threads, General Purpose, Inch

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA B70, Cast iron soil pipe, fittings, and means of joining.

.2 CAN/CSA B602, Mechanical couplings for drain, waste, and vent and sewer pipe.

.3 CAN/CSA B182.2, PSM Type Polyvinylchloride (PVC) Sewer Pipe and Fittings.

.4 Deutsches Institut für Normung (DIN)

.1 DIN19580 / EN 1433, Drainage Channels For Vehicular And Pedestrian Areas

1.3 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings: Submit shop drawings for all products specified in this Section except pipe and fittings. Shop drawings are to include all components including but not limited to panel layout drawings, wiring diagrams with wire numbers, individual components within panel, motor shop drawing, etc.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 FLOOR DRAINS (FD & FFD)

.1 Epoxy coated cast iron body, each complete with a 12 mm (1/2”) diameter trap primer connection, and each in accordance with the Floor Drain Schedule below.

.2 All floor drains in areas with a tile or sheet vinyl finish are to be as above but with a square grate in lieu of a round grate. Refer to the Room Finish Schedule.

.3 Strainers shall be adjustable nickel bronze, 6.35 mm (1/4") thick, and secured with vandalproof stainless steel (S.S.) screws. In locations with heavy duty vertical loads (>2500 lbs) a S.S. strainer shall be used in lieu of nickel bronze.

.4 Funnel floor drains shall come complete with a polished nickel bronze funnel assembly with vandalproof S.S. screws, each in accordance with the Floor Drain Schedule below.

2.2 SCUPPER DRAINS (SD)

.1 Epoxy coated cast iron body, each complete with a 12 mm (1/2") diameter trap primer connection, and each in accordance with the Floor Drain Schedule below.

.2 Epoxy coated cast iron strainer, angled or flush grate in accordance with the Floor Drain Schedule below.

2.3 INTERIOR AREA DRAIN (AD)

.1 Parking area drain shall be in accordance with CSA S413M and the Floor Drain Schedule below.

.2 Epoxy coated cast iron body with deep sump body, sediment bucket, wide anchor flange, weepholes, and adjustable collar.

.3 Extra heavy-duty ductile iron grate (ANSI A112.21.1M). Grate shall be anti-tilt hinged, slotted, and complete with stainless steel hinge pins

2.4 INTERIOR CATCH BASIN (CB)

.1 Acceptable products have been listed in the Floor Drain Schedule at the end of this section.

.2 High density polyethylene catch basin, 610 x 610 x 610 mm (24 x 24 x 24 in), water proof and highly resistant to a variety of chemical products, extra-heavy duty galvanized steel frame and grate as per application Product's notes : Foresee 4 inch min. concrete slab surrounding the catch basin to respect manufacturer recommendations.

.3 Heavy duty galvanized ductile iron trench drain grate, 572 x 610 mm (22 1/2 x 24 in) in length, class DIN F. Sediment bucket for catch basin, stainless steel with perforations, handles.

.4 Catch basin outlet connection 76mm (3 in), 102 mm (4 in) for basins 6 x 20 in and 12 x 24 in, 152 mm (6 in), 203 mm (8 in) for basins 6 x 20 in, 12 x 24 in and 24 x 24 in.

2.5 INTERIOR TRENCH DRAIN FRAME AND GRATE (TD)

.1 Pre-slopped high density polyethylene trench drain water proof and highly resistant to a variety of chemical products, interlocking section of 2438 mm (96") in length by 305 mm (12") in width, extra-heavy duty galvanized 8 foot frame for trench drain, integral rebar clips, 286 mm (11 1/4") grates as per application. Product's notes : Foresee 4 inch min. concrete slab surrounding the trench drain to respect manufacturer recommendations.

.2 Extra-heavy duty galvanized ductile iron trench drain grate, 286 x 610 mm (11 1/4 x 24 in) in length (4 grates required per trench), class DIN E.

.3 Trench drain closed end cap. Trench drain 102 mm (4 in), 152 mm (6 in), 203 mm (8 in) end connection. Joint connection for nose to nose installation.

.4 Acceptable products have been listed in the Floor Drain Schedule at the end of this section. Other acceptable equivalents from the following manufactures may be submitted for review and acceptance during contract administration:

.1 Zurn

.2 Watts

.3 J.R. Smith

.4 Mifab

2.6 HUB DRAIN (HD)

.1 Welded 304 stainless steel, Schedule 10, hub drain equivalent to AWI Manufacturing “Stainless Steel Hub Drains”.

.2 Funnel shall be oval and/or round.

.1 If round the funnel diameter shall be a minimum 2” (50mm) larger than outlet pipe.

.2 If oval long dimension of funnel shall be a minimum 2” (50mm) larger than outlet pipe, short dimension shall be at minimum the same size as the outlet pipe.

.3 Hub drain shall be connected directly drainage system, drainage system piping shall transition to metallic piping before penetrating floor slab.

.4 Pipe through floor slab shall surrounded by a minimum 150mm high concrete curb, refer to contract Drawings.

3 Execution

3.1 INSTALLATION OF FLOOR DRAINS, HUB DRAINS, SCUPPER DRAINS, & AREA DRAINS

.1 Provide and install drains where shown on the Drawings. Equip each drain with a trap and trap primer line.

.2 Confirm the exact location of drains based on architectural drawings prior to roughing in, coordinate installation with formwork installation.

.3 In equipment rooms and similar areas, exactly locate floor drains to suit the location of mechanical equipment and equipment indirect drainage piping.

.4 Temporarily plug floor drains during construction procedures. Remove plugs during final cleanup work and demonstrate free and clear operation of each drain. Replace any damaged grates.

3.2 INSTALLATION OF INTERIOR CATCH BASIN

.1 Supply and install all interior catch basins where shown, including all sump inlet and outlet piping and accessories.

.2 Install catch basins in place prior to the concrete trade pouring concrete, coordinate installation of sump piping with the formwork installation.

3.3 INSTALLATION OF TRENCH DRAIN FRAME AND GRATE

.1 Provide Trench Drain frame and covers where shown on the drawings.

.2 Coordinate installation of frame and covers with the concrete trade prior to pouring the trench drain sump, further to this coordinate the location of all scupper drains within the formwork.

.3 Contractor shall follow manufacturer’s installation guidelines to ensure a seamless and secure installation that does not compromise the load rating of the frame and grate system. Use co-plane straps to keep rails parallel.

.4 Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface.

.5 Field measure final frame and cover length requirements.

PART 4 - FLOOR DRAIN SCHEDULE

Type and Description	Zurn Model No.	J.R. Smith Model No.	Mifab Model No.	Watts Model No.
FD – 1 Floor drain, finished areas: Floor drains shall be round 127 mm (5") dia strainer, 100 mm (4") throat on strainer. Nickel bronze or S.S. as per 2.1(C).	ZN-415-B5-P-VP	2005-A05-NB-U-P050	F1100-C-5-1-7-6	FD-100-A5-1-6
FD – 2 Floor drain, finished areas, no membrane: Floor drains shall be round 127 mm (5") dia strainer, 100 mm (4") throat on strainer. Nickel bronze or S.S. as per 2.1(C).	ZN-211-A5-P-VP	1753-A05-NB-U-P050	F1100-5-1-7-6	FD-200-A5-1-6
FD – 1 Floor drain, tiled areas: Floor drains in quarry or mosaic tiled areas shall be similar to other floor drains but c/w 127 mm x 127 mm (5" x 5") square nickel bronze strainer. Nickel bronze or S.S. as per 2.1(C).	ZN-415-Y5-P-VP	2005-B05-NB-U-P050	F1100-C-S5-1-7-6	FD-100 -L5-1-6
FD – 3 Floor drain, tiled areas, no membrane: Floor drains in quarry or mosaic tiled areas shall be similar to other floor drains but c/w 127 mm x 127 mm (5" x 5") square nickel bronze strainer. Nickel bronze or S.S. as per 2.1(C).	ZN-211-Y5-P-VP	1753-B05-NB-U-P050	F1100-S5-1-7-6	FD-200-L5-1-6
FD-4 Floor drain, battery rooms Floor drains in battery rooms shall be FRPP body with anchor flange and no hub outlet c/w adjustable square heavy duty stainless steel strainer.	-	-	-	FDSS/PPS
SHD-1 Shower Drain: adjustable head and nickel strainer to meet finished floor elevations. The drain is furnished with a PVC or ABS body and clamping collar. Beveled clamping provides easier sub-floor installation. Fits over 2 (51mm) and inside 3 (76mm) schedule 40 DWV pipes.	-	-	-	FD2254-S5
FFD – 1 Funnel floor drain, no membrane: Funnel floor drains shall be similar to floor drains but c/w nominal 75 mm x 225 mm (3” x 9”) oval funnel.	ZN-211-BF	1753-A05-3591	F1100-EF-1	FD-200-EG-1

SD-3 – Scupper Drain c/w BWV, Pits: Scupper drains shall be angled pit type. 280 x 117mm (11" x 4.60")	Z-629	9790	BV-1210	BV-600
AD – 1 Area drain: Area drains shall be 300 x 300 mm (12" x 12"). Load rating to be capable of supporting local traffic.	ZC-535-CI-TE	SQ-2-2347	F1510-80-15	FD-490-F-4-ATE-80
CB – 1 Area catch basin: Catch basins shall be 610 x 610 mm (24" x 24"), and a minimum of 610 mm (24") deep. C/w sediment bucket, side outlet, and hinged extra heavy duty galvanized ductile iron grate with load rating capable of supporting local traffic.	Z887-GFA	9960-ME	F1570-B	CB-2424
TD – 1 Trench drain, frame & grate: 300mm (12") wide extra heavy duty galvanized ductile iron continuous grate, overall length to suit drawings and site conditions. Water proof and highly resistant to chemical products. Load rating to be capable of supporting local traffic.	Z882-HDG-HDGFEC	9960-M	T1800-PG-4-13	DX-GDI

END OF SECTION

1 General

1.1 SUMMARY

.1 This section includes the design and material requirements of oil and sediment interceptors.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 22 13 16 – Drainage, Waste, and Vent Piping.

.3 Section 22 13 19 – Drainage, Waste, and Vent Piping Specialties.

1.3 REFERENCE STANDARDS

.1 ASTM International Inc.

.1 ASTM A48, Standard Specification for Gray Iron Castings.

.2 Canadian Standards Association (CSA International)

.1 CAN/CSA B602, Mechanical couplings for drain, waste, and vent and sewer pipe.

.2 CAN/CSA B182.2, PSM Type Polyvinylchloride (PVC) Sewer Pipe and Fittings.

.3 American Association of State Highway and Transportation Officials (AASHTO)

.1 AASHTO M306, Standard Specification for Drainage, Sewer, Utility, and Related Casting.

.4 International Association of Plumbing and Mechanical Officials (IAPMO)

.1 IAPMO PS 80-2008, Clarifiers.

1.4 DEFINITIONS

.1 FRP: Fiberglass-reinforced plastic.

.2 OI: Oil and sediment water Interceptor

1.5 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Product Data: Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

.3 Shop Drawings: For each type and size of interceptor indicated.

.1 Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

.4 Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from Installers of the items involved:

.1 Interceptors.

.2 Piping connections. Include size, location, and elevation of each.

.3 Interface with underground structures and utility services.

2 Products

2.1 INTERCEPTOR TYPES

.1 All interceptors shall be based on an elliptical fiberglass (FRP) tank system designed with built-in inlet piping and baffle penetration that introduces wastewater in a tangential laminar flow to reduce

disruption of collected hydrocarbon oil, sediment and solids. The tank system shall be designed to capture and hold waste fluids and solids to maximize waste retention and optimize Stokes Law separation. System backed by 30-year manufacturer warranty.

.1 OIL AND SEDIMENT INTERCEPTOR OR SEPARATOR: Provide as specified in Schedules, interceptor shall be certified to meet IAPMO PS 80-2008 and applicable sections of the latest editions of the National Plumbing Code. Interceptor is designed to deliver 10 PPM non-emulsified free-floating oil and 350 PPM Total Suspended Solids effluent quality based on inlet peak fixture flow.

.2 CLARIFIER: Provide as specified in Schedules, interceptor shall be certified to meet IAPMO PS 80-2008 and applicable sections of the latest editions of the National Plumbing Code. Interceptor is designed to deliver 10 PPM non-emulsified free-floating oil and 350 PPM Total Suspended Solids effluent quality based on inlet peak fixture flow.

.3 FLAMMABLE OIL AND SOLIDS INTERCEPETOR OR SEPARATOR: Provide as specified in Schedules, interceptor shall be certified to meet IAPMO PS 80-2008 and applicable sections of the latest editions of the National Plumbing Code. Interceptor is designed to deliver 10 PPM non-emulsified free-floating oil and 350 PPM Total Suspended Solids effluent quality based on inlet peak fixture flow.

2.2 PERFORMANCE REQUIREMENTS

.1 Elliptical Fiberglass (FRP) oil interceptor construction, with inlet piping and baffle penetration designed to introduce wastewater in a tangential laminar flow pattern, to be appropriately sized based on anticipated usage and flow rates to meet applicable sanitary sewer discharge limits, incl. municipal by-laws.

.1 Include accessways, cells or baffles, and piping or openings to retain hydrocarbon and solids and to permit wastewater flow.

.2 Factory installed Schedule 40 PVC cement welded type socket ports, or straight pipe, fitted into interceptor walls for each pipe connection.

.3 Accessway Extension Collar:

.1 Fiberglass risers (EC2), to suit site conditions.

.4 Accessway Frames and Covers: Round cover with nonslip cover finish, gasketed and non-vented top design with “Proceptor” lettering cast into cover.

.1 Cast Iron: AASHTO M306 Traffic load rated. 24 inch- (610-mm) diameter cover with 0.25” (6-mm) gasket. Two closed pickholes. Non Bolted or Bolted option. Weight 249 lbs. ASTM A48 CL35B.

.2 Fiberglass: Pedestrian loading 24” diameter bolted and gasketed.

.5 Watertight Flexible Caulking: Sikaflex 255 or Sikaflex 221 or approved alternate to provide watertight seal at extension collar joints.

.2 Capacities and Characteristics for Oil Interceptors shall be provided as listed in the Schedules.

.1 Provide alarm for high oil accumulation. Includes alarm probe to be installed near top of tank accessway and alarm panel for indoor wall mount. Provide 120/1/60 and 25mm conduit from oil interceptor to nearest BAS panel.

2.3 FIBERGLASS ACCESSWAY RISERS

.1 Fiberglass accessway extensions: Fiberglass wound pipe.

.1 Length: From top of underground tank to underside of access frame at grade.

.2 Extension Sections: 0.25-inch (6 mm) minimum thickness and 24-inch (610 mm) as a single continuous piece, without joints unless approved by the manufacturer.

.3 Sealant: Watertight Flexible Caulking, Sikaflex 255 or Sikaflex 221 or approved alternate to provide watertight seal at extension collar joining to tank on bottom and access frame at top.

3 Execution

3.1 EARTHWORK

.1 Excavating, trenching, and backfilling are specified in Section 20 05 00 - General Requirements.

3.2 INSTALLATION

.1 Install and test fiberglass interceptors according to manufacturer's installation instructions.

.2 Once construction activities have completed, conduct sampling and testing to ensure oil and silt is being retained by the interceptor at the design flow rate.

3.3 CONNECTIONS

.1 Piping installation requirements are specified in Section 22 13 16 – Drainage Waste and Vent Piping. Drawings indicate general arrangement of piping, fittings, and specialties.

.2 Make piping connections between interceptors and piping systems.

3.4 IDENTIFICATION

.1 Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.

.1 Use warning tapes or detectable warning tape over ferrous piping.

.2 Use detectable warning tape over nonferrous piping and over edges of underground structures.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements

1.2 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM International)

.2 ASTM A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

.3 ASTM A743, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

.4 ASTM A48, Standard Specification for Gray Iron Castings.

.5 American Society of Mechanical Engineers (ASME)

.6 ASME B1.20.1, Pipe Threads, General Purpose

.7 National Building Code 2020 (NBC)

1.3 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings: Submit shop drawings for all products specified in this Section except pipe and fittings. Shop drawings are to include all components including but not limited to basin, lift out rail system, valves, pump, control panel layout drawings, wiring diagrams with wire numbers, individual components within panel, motor shop drawing, etc.

.3 Test Data: Submit the following test data prior to application for Substantial Performance of the Work.

.1 Pipe leakage test sheets in accordance with Section 20 05 00 – General Mechanical Requirements.

.2 A copy of the plumbing inspection certificate.

.3 Any other start-up or test data from equipment specified in this Section.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 60 00 – Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 SUMP BASIN

.1 The basin package shall be cast-in-place concrete provided by the structural contractor and include the following: break away fitting lift out system with guide rails, isolation valve, mechanical floats, basin cover, check valve, lifting chain, field locatable conduit fitting, and vent. All equipment in the wet well shall be capable of constant submerge in sewage to a minimum depth of 30 feet without electrical power being energized.

.2 Pump Removal and Rail System:

.1 Each basin shall be equipped with a 304 stainless steel pipe guide rail assembly to facilitate removal of the pump(s) from ground level.

.2 A stainless-steel lifting chain with harness shall be supplied for pump removal.

.3 Pump removal system shall include the use of a break away fitting that must not require the loosening of fasteners to facilitate pump removal and shall provide for automatic alignment and re-connection of discharge piping for the replacement pump.

.4 Pump replacement shall be capable of being accomplished while the basin is full of sewage without the need to dewater the basin.

.3 Basin Cover:

.1 Mechanical contractor to provide the lid.

.2 Provide a steel cover for all basins.

.3 Basin covers shall be flush with finished floor and provided with all necessary mounting hardware.

.4 Covers shall have a minimum load rating of 732 kg/sq. m (150lb/sq. ft.) and/ or according to slab loading rating.

2.2 SUMP PIT FRAME AND ACCESS HATCH

.1 Furnish and install vault access door for each cast-in-place sump pit, size shall match dimensions as shown on the Architectural/Structural Drawings. The floor access door shall be single leaf and pre-assembled from the manufacturer.

.2 Performance characteristics:

.1 Cover(s): Shall be reinforced to support a minimum live load of 1464 kg/m2 (300 psf) with a maximum deflection of 1/150th of the span.

.2 Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

.3 Operation of the cover shall not be affected by temperature.

.3 Cover: Shall be 6mm (1/4”) steel diamond pattern.

.4 Frame: Channel frame shall be 6mm (1/4”) steel with full anchor flange around the perimeter.

.5 Hinges: Shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.

.6 Drain Coupling: Provide a 38mm (1-1/2”) drain coupling located in the right front corner of the channel frame (note: can be placed at a different location if specified).

.7 Lifting mechanisms: Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe fastened to a formed 6mm (1/4”) gusset support plate.

.8 A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug.

.9 Hardware

.1 Hinges: Heavy forged brass hinges, each having a minimum 10mm (3/8") diameter Type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame.

.2 Cover shall be equipped with a hold open arm which automatically locks the cover in the open position.

.3 Cover shall be fitted with the required number and size of compression spring operators.

.4 A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.

.5 All hardware shall be zinc plated and chromate sealed with type 316 stainless steel fasteners.

.10 Finishes: Factory finish shall be red oxide primed steel.

.11 Acceptable manufacturers:

.1 BILCO Company - Type J, Channel Frame Access Door

.2 Acudor – Model FC-300, Channel Frame Access Door

.3 Nystrom – Model FDDP, Channel Frame Access Door

2.3 DISCHARGE PIPING, & FITTINGS

.1 Stainless Steel – Threaded Joint: Type 304 Schedule 40, ASTM A312, seamless stainless-steel piping complete with Class 150, ASME B1.20.1 NPT threaded fittings (ASTM A743) and screwed joints.

.2 Shut-off Valves: Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass or bronze body, blowout-proof stem, chrome plated brass ball, solder, or screwed ends as required, and removable lever handle. Where piping is insulated provide stem extensions to clear insulation.

.3 Ball Check Valves: ASTM A48 Class 30, epoxy coated cast iron, minimum 1725 kPa (100 psi) WOG rated ball check valve with screwed ends, for horizontal and vertical piping. Check valve to be designed specifically for storm and wastewater applications. Self-cleaning, natural rubber or nitrile (Buna-N) ball weighted depending on application.

2.4 SUMP PUMP AND CONTROLS

.1 Refer to mechanical equipment schedules for pump unit performance requirements.

.2 A duplex pump unit, when noted as such in the mechanical equipment schedules, shall be two (2) vertical, submerged, volute centrifugal pumps mounted below a cover plate; a vertical, flexible-connected, solid-shaft motors; motor and bearing support housing attached to the cover plate; pump support and shaft housing pipes; discharge pipes; and automatic controls. Installation of the unit shall permit removal of one pump assemble without disturbing the operation of the other.

.3 A cast iron (ASTM A-48) pump casing, motor cover and pressure switch housing, complete with stainless steel fasteners.

.4 An oil filled, overload protected submersible motor with a minimum of 3 m (10 feet) of PVC jacketed power cord prewired to the motor.

.5 An open, two-vane type, non-clog cast iron impeller secured to a 400 series stainless steel pump and motor shaft.

.6 For duplex pump unit: Four Control Switches: Snap Action, each sealed in a polypropylene float and complete with a minimum of 3 m (10 feet) of power cord, three float switches for pump "PUMP 1 ON", "PUMP 2 ON" & "OFF" control, the other float switch for high water level alarm. Provide external float weights for an accurate pivot point. Type 304 or 316 steel float and rod are also acceptable.

.7 Wall Mounted Control Panel:

.1 Provide NEMA 12 enclosures for indoor applications, provide lockable NEMA 4x enclosures for outdoor applications,

.2 Fused disconnect switch,

.3 Magnetic Motor Starter/Contactor,

.4 Float Switch Terminal Block

.5 HOA switch

.6 Pump "ON" green LED,

.7 Alarm with red flashing LED which remains illuminated until the alarm is cleared,

.8 Audible bell with alarm silencing switch,

.9 BAS interface

.8 Provide auxiliary contacts for remote annunciation to BAS. Provide additional panels, if required.

.1 "GENERAL FAULT" (inclusive of power loss, overload, and/or switch in HAND or OFF position)

.2 "HIGH LEVEL ALARM" status

.3 "PUMP ON/OFF" status.

.9 A stainless steel bracket to support float switch cables in the sump pit.

.10 Acceptable manufacturers:

.1 Grundfos Canada Inc.

.2 Armstrong Fluid Technology Ltd.

.3 Bell & Gossett Inc. (Xylem Inc.)

3 Execution

3.1 INSTALLATION OF SUMP BASIN

.1 Coordinate pit/basin location and installation within Division 03 (Concrete) for sleeving through concrete slab, bedding, and ballast.

.2 Provide bedding, ballast and backfill material as required by manufactures recommendations. In absence of a manufacture recommendation consult specifying Contract Administrator before installation.

.3 Ensure pits have all required inlet and outlet connections for piping and wiring; locate all connections at the correct elevations.

3.2 PIPING INSTALLATION REQUIREMENTS

.1 Provide all required drainage, waste, and vent piping. Pipe, unless otherwise specified in the Contract Documents, shall be as follows:

.1 For sanitary and storm pump discharge piping connected within the sump basin provide 304 Stainless Steel piping.

.2 After the discharge piping has been connected to the gravity sanitary or storm system; the piping material type shall transition to the material specified in Section 22 13 19 – Drainage Waste and Vent Piping Specialties.

.2 Provide venting pipe for sump basin as required by NBC and manufacturer. Venting pipe material and installation requirements shall follow specification Section 22 13 19 – Drainage Waste and Vent Piping Specialties.

3.3 INSTALLATION OF SUMP PUMP AND CONTROLS

.1 Provide submersible drainage pump(s) on a mounting base in the sump.

.2 Provide all required sump piping, including a shut-off valve and a check valve for each pump. Ensure that piping is easily removable for removal of pump(s) from the sump.

.3 Provide guide rail/lifting system for pumps installed in sump pits 2m (6.5 ft) or deeper.

.4 Install float switch(es) at the proper height in the sump and secure cable to a sump wall mounted bracket such that cables cannot twist around each other, coordinate power and BAS interface with other divisions.

.5 Electrical trade (Division 26) to provide connection location for the Control Panel, installation of all power and control cables downstream of the panel, including extension and connection to starting and control equipment shall be part of the mechanical work of Division 22.

.6 Hand the pump starter and control panel(s) and highwater level alarm panel(s) to the electrical trade (Division 26) at the site for installation.

.7 Provide sump and pump accessories.

.8 Clean sump(s) prior to application for Substantial Performance.

.9 Arrange for the pump supplier to visit the site to examine the installation and certify it correct in writing, to supervise start-up and test operation, and to demonstrate proper operation and maintenance procedures. Submit a copy of the certification letter.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 22 13 16 – Drainage, Waste, and Vent Piping.

.3 Section 22 13 19 – Drainage, Waste, and Vent Piping Specialties.

1.2 REFERENCE STANDARDS

.1 ASTM International Inc.

.1 ASTM A48, Standard Specification for Gray Iron Castings.

.2 ASTM A536, Standard Specification for Ductile Iron Castings

.2 American Society of Mechanical Engineers (ASME)

.1 ASME B1.20.1, Pipe Threads, General Purpose, Inch

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA B70, Cast iron soil pipe, fittings, and means of joining.

.2 CAN/CSA B602, Mechanical couplings for drain, waste, and vent and sewer pipe.

1.3 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings: Submit shop drawings for all products specified in this section. Provide the manufacturer's printed product literature and datasheets including product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 – Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 ROOF DRAINS (RD)

.1 15" (381mm) Diameter Control-Flo roof drain for dead-level roof construction, Dura-Coated cast iron body, Control-Flo weir shall be linear functioning with integral membrane flashing clamp/gravel guard and Poly-Dome. All data shall be verified proportional to flow rates. Each notch will allow 10 GPM of flow per 1" (25mm) of rainwater build up above the drain.

2.2 SCUPPER DRAINS (SD)

.1 Epoxy coated cast iron body with flashing/membrane clamp, each in accordance with the “Roof Drain Schedule” below.

.2 Epoxy coated cast iron strainer, 45-degree angled or flush grate in accordance with the “Roof Drain Schedule” below.

3 Execution

3.1 INSTALLATION OF ROOF & SCUPPER DRAINS

.1 Supply roof drains and place roof drain bodies in position for flashing into roof construction as part of the roofing work. Connect with piping and provide accessories.

.2 Protect roof drains from damage and entrance of debris until roofing work is complete.

.3 Ensure roof drains are installed at low points of roof and co-ordinate locations with requirements of all disciplines.

3.2 INSTALLATION OF OVERFLOW ROOF DRAINS

.1 Supply roof drains and place roof drain bodies in position for flashing into roof construction as part of the roofing work. Connect with piping and provide accessories.

.2 Protect roof drains from damage and entrance of debris until roofing work is complete.

.3 Ensure overflow roof drains with 100mm high water dams are installed 50mm higher than flow control roof drains. Inlet into standpipe shall be exactly 150mm above low point of roof, co-ordinate locations with requirements of all other disciplines.

PART 1: ROOF DRAIN SCHEDULE

Type and Description	Zurn Model No.	J.R. Smith Model No.	Mifab Model No.	Watts Model No.
RD-1, 375mm (15 in) diameter body control flow drain, for conventional roof.	Z-105	1085	R1200 -B-E-U-M	RD-100-A-ADJ
SD-1 Scupper Drain, 300 to 400 mm (12 to 16 in.) diameter body, combination roof drain and overflow drain, for conventional roof. Overflow shall have a 100mm (4 in.) high dam (stand-pipe). – 200 mm (8 in.) pipe size	ZA-163-EA-W4	1800-AE-WD4-AD	R1270-E-U-M	RD-700-DF-K80
SD-2 Scupper Drain, 300 to 400 mm (12 to 16 in.) diameter body, combination roof drain and overflow drain, for conventional roof. Overflow shall have a 100mm (4 in.) high dam (stand-pipe). – 150 mm (6 in.) pipe size	ZA-163-EA-W4	1800-AE-WD4-AD	R1270-E-U-M	RD-700-DF-K80

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section includes piping, specialties, equipment and services necessary for the compressed air system Work in accordance with the Contract Documents, including but not limited to, following:

- .1 Screw type air compressors: variable and fixed speed.
- .2 Reciprocating compressor
- .3 Air receiver tanks,
- .4 Refrigerated air dryers,
- .5 Inline filters,
- .6 Automatic drains
- .7 Pressure regulation.
- .8 Controls for compressor sequencing
- .9 Testing, and commissioning, and submittal of all required documents.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 29, Hangers and Supports.

.2 Section 20 05 93, Testing, Adjusting and Balancing (TAB) of Mechanical Systems.

1.3 REFERENCE STANDARDS

.1 ASME

- .1 ANSI/ASME B1.20.1, Pipe Threads, General Purpose, Inch.
- .2 ANSI/ASME B31.1, Power Piping.
- .3 ASME B16.3, Malleable Iron Thread Fittings.
- .4 ASME B16.5, Pipe Flanges and Flanged Fittings: NPS ½ through 24.
- .5 ASME B16.11, Forged Fittings, Socket-Welding and Threaded.

.2 ASTM

- .1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- .2 ASTM A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
- .3 ASTM A106, Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service.
- .4 ASTM A 511-96. Seamless Stainless Steel Mechanical Tubing

.3 CSA

- .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
- .2 CSA C22.1 - Canadian Electrical Code, Part I (26th Edition), Safety Standard for Electrical Installations

.4 International Standards Organisation

- .1 ISO 1217, Displacement compressors – Acceptance tests.

.2 ISO 2151, Acoustics – Noise test code for compressors and vacuum pumps.

.3 ISO 7183:2007 Compressed-air dryers — Specifications and testing

.4 ISO 8573-1:2010 Compressed airPart 1: Contaminants and purity classes

.5 SAE

.1 SAE J515, Specification for Hydraulic O-Ring Materials, Properties and Sizes for Metric and Inch Stud Ends, Face Seal Fitting and Four Screw Flange Tube Connections.

.2 SAE J516, Hydraulic Hose Fittings.

.3 SAE J517, Hydraulic Hose.

.4 SAE J343, Test and Test Procedures for SAE 100R Series – Hydraulic Hose and Hose Assemblies.

1.4 SUBMITTALS

.1 Submit the following product data and shop drawings in one package.

.1 Product data:

.1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 for all Products listed in this Section, indicating:

.1 Performance criteria, compliance with appropriate reference standards, characteristics, limitations, and troubleshooting protocol.

.2 Motor data and product data for all optional accessories.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00, indicated on drawings:

.2 Shop Drawings shall include all the major systems including and not limited to the following information:

.1 Air compressor

.2 Lubricating Oil

.3 Overall system information

.4 Air dryer

.5 Filters

.6 Receiver

.7 Automatic drain and condensate pumping

.8 Piping Systems.

.9 Piping, fittings, valves.

.10 System purging and cleaning procedures and products.

.11 Quick connectors

.12 Electrical.

.1 Single line wiring diagram showing all devices and electrical components.

.2 Controls.

.3 Control Panel features and alarms.

.13 Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.

.14 Complete wiring diagrams including schematics.

.15 Dimensions, construction details, materials, recommended installation and support, mounting bolt holes, sizes and locations, and point loads.

.16 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Commissioning:

.1 Submit Commissioning Plan, Commissioning Procedures, Certificate of Readiness, Deficiency Report and Commissioning Closeout Report.

1.5 CLOSEOUT SUBMITTALS

.1 Submit following for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 00:

.1 Identification: Manufacturing name, type, year, serial number, number of units, capacity, and identification of related systems.

.2 Functional description detailing operation and control of components.

.3 Performance criteria and maintenance data.

.4 Operating instructions and precautions.

.5 Safety precautions.

.6 Component parts availability including names and addresses of spare part suppliers.

.7 Consumables.

.8 Lubrication schedule indicating lubrication points and type of lubricant recommended.

.9 Maintenance and troubleshooting guidelines/protocol, and recommended equipment for analysis and repair.

.10 List of items submitted to Commission’s Representative as required: Keys, tools, special devices, maintenance materials.

1.6 QUALITY ASSURANCE

.1 Manufacturer’s representative to:

.1 Supervise installation of equipment.

.2 Start-up testing.

.3 Performance verification testing.

.4 Commissioning.

.5 Certify installation.

.6 Conduct training sessions.

.2 Installer’s qualifications:

.1 Employ installer approved by Technical Standards and Safety Authority, in the Province of Project to install systems listed herein. File Quality Plan with the TSSA.

.2 Certified welders and valid procedures.

.3 Certified pipe fitters.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect garage systems equipment from scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 Products

2.1 ROTARY SCREW AIR COMPRESSORS

.1 Compressors – general requirements

.1 CSA/UL listed

.2 Capacity as indicated on the schedules on the drawings.

.3 Steel skid with sound attenuating enclosure

.1 Maximum: 68dBa at 1m.

.4 Air cooled, Single stage design

.5 Intake section:

.1 Isolated dry-type air intake filter

.2 Minimum 95% for particle down to 3 microns.

.6 Differential pressure monitoring

.7 Direct gear drive power transmission

.8 TEFC Inverter Duty Rated High Efficiency Motor

.9 ASME approved air/oil separator

.10 Integrated after cooler with built-in water separator

.1 Automatic drain control

.11 Controls:

.1 Microprocessor / PLC based.

.2 Master compressor control system for coordination of compressed air system operation using:

.1 One fixed speed compressor

.2 One variable speed compressor.

to provide the most power and cost effective operating scenario.

.3 NEMA12/IP54 electrical/control panel:

.4 Minimum 85mm high definition colour display

.1 Graphical display of key parameters.

.5 Ethernet connectivity.

.6 Continuous output monitoring and data logging.

.7 Delayed second stop to automatically reduce no-load running time.

.12 Power:

.1 575V/3Ph/60Hz

.2 Single point power connection.

.13 Acceptable product:

.1 Ingersoll Rand

.2 DV

.3 Atlas Copco

.4 Approved equivalents.

2.2 COMPRESSOR – VARIABLE SPEED

.1 Oil injected

.2 Turn down: minimum 75%

.3 As per fixed speed compressor.

.4 Acceptable product:

.1 Shall be as same make as the variable speed compressor.

2.3 COMPRESSOR – RECIPROCATING – TIRE FILL

.1 Operating Pressure: 865 kPa (125 psig)

.2 Duplex compressors on common horizontal receiver.

.3 Two stage V-type configuration

.4 Continuous duty

.5 Cast iron construction

.6 Finned cylinders

.7 Finned copper intercooler

.8 Stainless steel reed valves

.9 Synthetic lubricant

.10 Splash lubrication

.11 Low oil level swith

.12 Centrifugal unloader / load free start.

.13 Belt Drive

.14 Electrical and Controls

.1 TEFC motor

.2 575 volt / 3ph/ 60 hz.

.3 Magnetic starter

.4 Adjustable pressure switch

.1 Duty/standby control

.2 Alternating startup

.15 Rated operating temperature:

.1 Ambient room temperature: 37.8ºC (100ºF)

.16 Maximum sound pressure level: 74dBA @ 1m.

.17 Receiver:

.1 ASME design

.2 Province of Manitoba CRN

.3 Volume: 300 Litre (80 usg)

.4 Pressure relief valve

.5 Automatic drain valve

.18 Acceptable product:

.1 Ingersoll Rand

.2 DV

.3 Atlas Copco

.4 Approved equivalent.

2.4 COMPRESSED AIR STORAGE RECEIVERS

.1 Refer to schedules on the drawings.

.2 ASME rated to minimum 1140 kPa.

.3 Welded steel construction.

.4 CRN for Province of Manitoba

.5 Automatic condensate drain.

.6 Acceptable product:

.1 Samuel Pressure Vessel Group

.2 Approved equivalent.

2.5 SAFETY RELIEF VALVE:

.1 Conforming to ASME Section VIII requirements for air/gas applications.

.2 CRN for Province of Manitoba

.3 Bronze body.

.4 Lapped metal seats, or O-ringed seating.

.5 Heavy duty lift lever assembly.

.6 Relief pressure setting to the lesser of:

.1 10% above the compressor safety pressure switch setting, or

.2 the receiver maximum working pressure rating.

.7 Valve sizing based on following compressed air system air flows:

.1 Refer to compressor schedules on the drawings. General compressed air

2.6 REFRIGERANT AIR DRYER

.1 Cycling, refrigerant type air dryer.

.2 Microprocessor controlled

.3 Air Cooled

.4 Designed for operation with:

.1 R404A refrigerant, or

.2 A2L (R32 or R454B) refrigerant shall be used if unit is supplied after Canadian R404A phase-out date.

.5 No-loss automatic condensate drain

.1 Maximum noise level: < 84 dBA

.2 Operating temperature:

.1 Room: to 49ºC (120ºF)

.2 Inlet air temperature: to 49ºC (120ºF)

.3 Pressure dew-point rating:

.1 3ºC (38ºF)

.4 Acceptable product:

.1 Screw compressor manufacturer's product

.2 Reciprocating compressor manufacturer's product.

2.7 IN-LINE MAIN SYSTEM PRESSURE REGULATOR

.1 Paint Booth Compressed Air:

.2 Rated for flow rate of 125 Litres/second at 690 kPa.

.3 37mm cast iron body

.4 416SST trim.

.5 Composite seat

.6 NBR disk

.7 Neoprene diaphragm

.8 Adjustable range: 100 to 865 kPa

.9 Acceptable product:

.1 Fisher MR 95H series regulator

.2 Compressor manufacturer's product line

.3 Approved equivalent

2.8 IN-LINE FILTERING

.1 Replaceable cartridge type filters

.2 Housings to include CRN for Province of Manitoba

.3 Filtered air quality:

.1 Conforming to ISO 8573-1 Class 2.4.2 Industrial Grade Air.

.4 Acceptable product:

.1 Compressor manufacturer's product line

.2 Parker

.3 Approved equivalent

2.9 PIPING AND VALVES

.1 Refer to schedules on the drawings.

.1 Carbon Steel for all size, ASTM A106 Gr.B, Schedule 40 seamless.

.2 Proprietary systems – TransAir, etc.

.2 Fittings:

.1 NPS 2 and smaller: Malleable iron, threaded, class 150.

.2 Proprietary system

.3 Joints:

.1 NPS 2 and smaller: threaded or flanged, class 150.

.2 Proprietary system

.4 Valves: Ball

.1 WOG

.2 Carbon steel 2 or 3 piece Body,

.3 Stainless steel ball. PTFE seat,

.4 Lockable lever actuator

.5 NPS 2 and smaller: threaded, class 150.

2.10 HOSES

.1 Flexible hose:

.2 Performance to SAE 100Rxx,

.3 Synthetic rubber tube, Braided wire reinforced

.4 Operating Temperature rating: 10°C to 40°C

.5 Acceptable product:

.1 Continental

.2 Gates

.3 Goodyear

.4 Approved equivalent.

3 Execution

3.1 INSTALLATION – GENERAL

.1 Install all systems required governed by the Boilers and Pressure Vessels Act to latest requirements of CSA B51 – Boiler, Pressure Vessel, and Pressure Piping Code, and all related codes and standards governing selection and installation of piping, fittings, joining methods, welding, valves, etc.

.2 Clean piping before installation. Remove rust and scale. Deburr pipe after cutting and chips after threading.

.3 Clearances:

.1 Maintain clearance around systems, equipment and components and between pipes and structures for Operation and Maintenance, as directed and to manufacturer's recommendations, for greater of:

.1 Observation of operation, inspection, servicing, maintenance.

.2 Disassembly, removal of equipment and components without interrupting operation of other system, equipment, components.

.2 Where required locate valves to permit installation of thermal insulation of pipes.

.4 Coordinate location of piping, valves and reels with ductwork, lights, building structure, and all other services.

.1 Perform trial bus drive-in scenarios with the City to confirm locations prior to finalizing location of overhead hose reels.

.2 City shall provide bus and operator.

.5 Provide necessary clearance for maintenance. Identify potential interferences to the Contract Administrator for resolution.

.6 Flanges: Use suitable graphite lubricant on bolts and nuts.

.7 Drain valves:

.1 Install at all low points in piping systems, at equipment, at section isolating valves and elsewhere as required, whether shown on Contract Drawings or not.

.2 Weld couplings for drains into piping to ANSI/ASME B31.1M.

.8 Firestopping: Make provision for sealing piping passing through walls with approved firestopping compatible with surface temperature of pipe or insulation.

.9 Brace piping securely to building structure, where pipe movement occurs due to valve and/or pump operation. Submit attachment details for approval.

.10 Branch take-offs:

.1 Use welding tees, socket or butt only.

.2 Where reducing tees of proper size are unavailable, use available tees with reducers. Tees with increasers not acceptable.

.3 Weld lets not acceptable.

.11 Cap open ends of piping during installation. Remove foreign material from inside piping.

.12 Flanges: Tighten bolts evenly with torque wrench.

.13 Revisions to location of piping require approval by the Contract Administrator. Prepare and submit Drawings of all proposed revisions.

.14 Connections to equipment: Provide pressure rated unions where hose assembly does not include a swivel joint.

3.2 FABRICATION OF PIPING

.1 Codes: Perform work in accordance with ANSI/ASME B31.1.

.2 Screwed joints:

.1 Provide clean machine cut threads.

.2 Use approved compound on male threads.

.3 Permitted only at last fitting (valve) of each pipe run.

.3 Branch connections:

.1 Use butt or socket weld fittings only.

.2 Weldolets, threadolets, or half couplings not permitted.

.3 Pipe to pipe welded branch connections not permitted.

3.3 WELDING

.1 Perform welding in accordance with requirements of ANSI/ASME B31.1.

3.4 HOUSEKEEPING

.1 Maintain good housekeeping of all materials and take every precaution necessary to ensure products not inadvertently mixed between systems.

.2 Protect all product certification markings from soiling and damage during handling and installation. Install and orient all equipment, piping, fittings, hoses, and valves so certification markings remain visible for inspection.

.3 Do not paint, cover or conceal system piping, valves, hoses, fittings, and especially certification markings until all inspections and pressure tests conducted successfully and system approved for operation by AHJ.

3.5 PIPE SUPPORTS

.1 In strict accordance with Section 20 05 29, and requirements of this Section.

.2 Provide to details as indicated on Contract Drawings.

.3 Submit shop drawings for review before fabrication and installation.

.4 Percussion type inserts not permitted unless shown otherwise.

.5 Power driven fasteners not permitted unless shown otherwise.

.6 Neatly arrange piping on common trapeze type hanger, and route piping to avoid interference with other mechanical services, electrical lights and wiring and building structure. Provide equal spacing between each pipe. Allow sufficient space on hanger system for other mechanical piping (domestic hot and cold water, tempered water, non-potable water) and coordinate to provide neatest possible piping routing through garage.

.7 Install to manufacturer's recommendations.

.8 Install to details indicated on Contract Drawings.

.9 Provide and install additional structural steel to support piping located between truss lines. Submit details of attachment to building prior to proceeding with work. Arrange and pay for qualified trades.

3.6 VALVES

.1 Install valves as required to isolate all branch lines.

.2 Install only steel valves for all flammable and combustible fluids.

.3 Install isolating valves at branch take-offs, at pieces of equipment and elsewhere as indicated.

.4 Install in accordance with manufacturer's recommendations.

.5 Install in accessible locations.

.6 Depending upon piping configuration and ease of operation, on horizontal pipes install with stem horizontal or above.

.7 Valves accessible for maintenance without removing adjacent piping.

.8 Isolation valves in main runs or branches: Socket weld or flanged.

.9 Valves at hose connections: Screwed unless indicated otherwise.

3.7 FILTERS

.1 Install in locations to allow easy access for removal of filter/cartridges.

3.8 PRESSURE TESTS

.1 Hydrostatic Pressure Test:

.1 Perform hydrostatic pressure tests on following systems:

.1 Any other system governed by the Boilers and Pressure Vessels Act and Code.

.2 Conduct tests in presence of City's representative, and as required by the AHJ.

.3 Give City and AHJ minimum of five (5) working days notice of intention to perform pressure tests.

.4 After installation and before concealing, perform hydrostatic pressure tests to 1.5 times maximum working pressure and maintain test pressure without loss or leaks for 24 hours.

.5 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or test media and indicate in test report.

.6 Bear costs for tests, for repairs or replacement, retesting, making good.

.7 Insulate or conceal work after approval and certification of tests by AHJ and City.

.8 Use test media indicated on Contract Drawings, and unless indicated otherwise, use fluid intended to be carried by each piping system.

.9 Supply new high quality accurately calibrated pressure gauges to verify test pressures, as specified under this Section. Submit bill of sale as proof gauges are new.

.10 Test gauges not new: Submit calibration certificate dated within one (1) month of test date.

.11 Replace all pressure gauges suspected to be faulty or out of calibration.

.12 Provide equipment that will safely and accurately generate test pressures, under controlled conditions, and without potential for human error. Submit proposed test equipment to City for approval.

.13 In accordance with above, test pressures may be generated as follows:

.1 Hydraulic hand pump (preferred).

.2 Piston pump controlled by regulated air supply.

.3 Electric pump with unloader or relief set to test pressure.

.4 Methods using on/off control of equipment to limit pressure not permitted.

.14 Any pressure test procedure found unsafe, in opinion of City representative of AHJ, will be cancelled and rescheduled at the Contractor's expense.

.15 Upon successful completion of pressure test for each individual pressure piping system, prepare and submit detailed test report.

3.9 PAINTING

.1 All painting performed by qualified trades.

.2 Do not cover pipe identification markings until City and AHJ have inspected them.

3.10 FLUSHING AND CLEANING

.1 Cleaning Solutions:

Compressed Air	Water/Air

.2 Timing: Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.3 Install products such as flow meters and dispensing valves only after cleaning certified as complete.

.4 Conditions at time of cleaning:

.1 Systems to be free from construction debris, dirt and other foreign material.

.2 Isolation valves to be operational, fully open to ensure terminal units can be cleaned

3.11 COMMISSIONING

.1 Perform Commissioning in accordance with Sections 01 91 00.

.2 Verify operational performance in general conformance with the following outline:

.3 Commissioning Method shall include:

.1 Instrumentation: Verify accuracy of pressure gauges by comparison with calibrated test instruments.

.2 Full scale tests:

.1 Upon completion, conduct full scale tests at specified operating pressure and air regulator setpoints.

.3 Dispense product at each dispenser for 30 seconds. Measure product dispensed. Calculate flow rate. If product flow excessive or inadequate, adjust air supply pressure.

.4 Reports.

3.12 START- UP OF PRESSURE SYSTEMS

.1 Timing: After:

.1 Cleaning is completed.

.2 Pressure tests are completed.

.3 Painting and identification is complete.

.2 Provide continuous supervision during start-up.

.3 Set pressure controls.

.4 Ensure air is removed and piping is fully charged.

.5 Clean / replace filters where installed.

.6 Check pressurization to ensure proper operation and flow at all dispensers.

.7 Check for leaks.

.8 Eliminate pipe vibration. Provide additional bracing to approval of City.

.9 Adjust pipe supports, hangers, springs as necessary.

.10 Monitor pipe movement, performance of anchors.

.11 Check operation of relief valves.

.12 Test operation of operating, limit and safety controls.

.13 Record pressure of air supply, pump supply and relief setting for each system.

.14 Fasten loose items of equipment to ensure quiet operation of system.

3.13 CERTIFICATES

.1 Complete and submit AHJ documentation.

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of the following:

.1 Domestic Hot Water Heaters

.2 Domestic Hot Water Tanks

.3 Circulating pumps

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

1.3 REFERENCE STANDARDS

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings

.2 Canadian Standards Association (CSA International)

.1 ANSI Z21.10.3/CSA 4.3, Gas-fired water heaters, volume III, storage water heaters with input ratings above 75,000 Btu per hour, circulating and instantaneous.

.3 Underwriters Laboratories (UL)

.1 UL353 Standard for Limit Controls

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Provide the Manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit shop drawings for all equipment listed in this Section.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.2 Deliver materials to site in its original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 MATERIALS

.1 Provide the following components as part of the section:

.1 Domestic Hot Water Heaters

.2 Domestic Hot Water Storage Tanks

.3 Storage Tank Circulating Pumps

.4 Air Source Heat Pump Water Heater

.5 Instantaneous Water Heaters

.2 Acceptable manufacturers:

.1 Hot water heaters: Lochinvar, AO Smith, Rheem, Viessmann, Aerco, Buderus

.2 Hot water storage tanks: Lochinvar, AO Smith, Rheem, Clemmer, PVI

.3 Refer to Schedules for capacities.

.4 Domestic hot water heater shall be air source heat pumps, or condensing type or operating on natural gas.

.5 The water heater shall bear the ASME "HLW" stamp and shall be National Board listed for inputs in excess of 200,000 Btu/hr. There shall be no banding material, bolts, gaskets or "O" rings in the header configuration. The stainless steel combustion chamber shall be designed to drain condensation to the bottom of the heat exchanger assembly. A built-in trap shall allow condensation to drain from the heat exchanger assembly. The complete heat exchanger assembly shall carry a five (5) year limited warranty

.6 The water heater shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.10.3 test standard for the US and Canada.

.7 The water heater shall comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard. The water heater shall be AHRI certified to 96% thermal efficiency. The water heater shall be certified for indoor installation.

.8 The water heater shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided. The burner shall be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates. The water heater shall be supplied with a gas valve designed with negative pressure regulation and be equipped with a variable speed blower system, to precisely control the fuel/air mixture to provide modulating water heater firing rates for maximum efficiency. The water heater shall operate in a safe condition at a derated output with gas supply pressures as low as 4” of water column

.9 The natural gas water heater shall be capable of full modulation firing down to 20% of rated input with a turn down ratio of 5:1

.10 Boilers shall be suitable for 860 kPa (125 psi) working pressure and complete with the following:

.1 High limit control set at 99 deg. C. (210 deg. F.)

.2 Fully modulating flame control

.3 Thermometers

.4 Pressure gauge

.5 Burner for operation on natural gas at 7 in. W.G. supply to gas train.

.6 A.S.M.E. safety relief valve

.7 Gas pressure regulator

.8 Electronic flame safeguard control

.9 100% shut-off pilot control

.10 Manual gas shut-off valve

.11 Blow-off pie with gate valve from lowest water space piped to drain

.12 Low water fuel cut-off

.13 Pre-wired control panel interconnected to all controls and wired to terminal strip

.14 Insulation and fireback linings

.15 Baked enamelled jacket

.16 Control lights

.11 The water heater shall utilize a 24 VAC control circuit and components. The control system shall have an electronic display for water heater set-up, water heater status, and water heater diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The water heater shall be equipped with; a high limit temperature control certified to UL353, ASME certified pressure relief valve, outlet water temperature sensor, inlet water temperature sensor, a UL 353 certified flue temperature sensor, low water flow protection and built-in freeze protection. The manufacturer shall verify proper operation of the burner, all controls and the heat exchanger by connection to water and venting for a factory fire test prior to shipping.

.12 The water heater shall feature the “Smart System” control with a Multi-Colored Graphic LCD display with Navigation Dial and Soft Keys, password security, pump delay with freeze protection, pump exercise, and USB PC port connection. The water heater shall feature night setback for the domestic hot water tank and shall be capable of controlling a building recirculation pump while utilizing the night setback schedule for the building recirculation pump. The water heater shall have the capability to accept a 0-10 VDC input connection for BMS control of modulation or setpoint and enable/disable of the water heater, and a 0-10 VDC output of water heater modulation rate. The water heater shall have a built-in cascading sequencer with modulation logic options of “lead lag” or “efficiency optimized”. Both modulation logic options should be capable of rotation while maintaining modulation of up to eight water heaters without utilization of an external controller.

.13 The water heater shall be equipped with two terminal strips for electrical connection. A low voltage connection board with data points for safety and operating controls, i.e., Auxiliary Relay, Auxiliary Proving Switch, Alarm Contacts, Runtime Contacts, Manual Reset Low Water Cutoff, Flow Switch, High and Low Gas Pressure Switches, Tank Thermostat, Tank Sensor, Building Management System Signal, Modbus Control Contacts and Cascade Control Circuit. A high voltage terminal strip shall be provided for supply voltage. The high voltage terminal strip plus integral relays are provided for independent control of the domestic hot water pump and building re-circulation pump.

.14 The water heater shall be installed and vented via a Vertical Vent with Room Air system with a vertical rooftop termination of the vent with the combustion air drawn from the interior of the building. The flue shall be Stainless Steel sealed vent material terminating at the rooftop with the manufacturers specified vent termination. The water heater’s total combined exhaust venting length shall not exceed 100 equivalent feet

.15 Storage tank shall be a vertical tank. The tank shall be constructed with an inner chamber designed to receive all circulation to and from the water heater to eliminate turbulence in the tank. The baffled tank shall supply 80% of tank capacity without a drop in outlet temperature.

.16 The storage tank shall be constructed in accordance with ASME requirements, stamped and registered with the National Board of Boiler and Pressure Vessel Inspectors. The storage tank shall have a working pressure of 150 psi. The storage tank shall be glass lined and fired to 871 deg. C (1600 deg. F) to ensure a molecular fusing of glass and steel, and carry a five (5) year limited warranty. The tank shall be constructed with a heavy gauge galvanized steel jacket assembly, primed and pre-painted on both sides. The jacket and tank base shall be a water tight construction with a built-in drain pan, complete with a ¾” drain connection to assist in protecting against damage in the event of a tank or component leakage. The Storage Tank shall be completely encased in high density insulation of sufficient thickness to meet the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard. The entire assembly shall be mounted on “I” beam skids to facilitate handling and installation.

.17 Storage tank circulating pump:

.1 The circulating pump shall be all bronze and operate on 120/1/60 power supply the pump shall be wired to run with intermittent pump operation.

.2 Pump shall be complete with built-in differential-pressure and temperature sensor.

.3 The pump between the domestic hot water heater and storage tank shall be as per equipment schedules.

.18 Air Source Heat Pump Water Heater:

.1 The heat pump shall be capable of performance listed in the schedule.

.2 The heat pump shall have a scroll compressor with additional control for monitoring operation of compressor. Control shall provide diagnosis of the compressor with indication lights for status and codes. Heat pump shall be factory charged with 513A refrigerant, ECM variable speed circulator pump, and double wall stainless steel condenser for potable water applications. The complete heat pump assembly shall carry a two (2) year limited warranty. Optional 5-year compressor warranty shall be offered by manufacturer.

.3 The heat pump shall adjust the Evaporator fan speed depending on ambient temperature to optimize the performance of the heat pump.

.4 The heat pump refrigerant circuit shall contain an electronic expansion valve, receiver, accumulator, filter drier and service ports for refrigerant gauges.

.5 The heat pump shall be certified and listed by UL to UL 60335-2-40 standard. The heat pump shall be certified for indoor and/or outdoor installation.

.6 The heat pump shall be constructed with a heavy gauge sheet metal assembly and painted on both sides. Manufacturer shall provide results of a 9,000-hour salt spray test.

.7 The heat pump shall utilize a 24 VAC control circuit and components. The control panel shall have a touch screen display for heat pump set-up, heat pump status, and heat pump diagnostics. All components shall be easily accessed and serviceable. Control panel shall be remote mountable, inside or outside installation is acceptable.

.8 The heat pump shall be equipped with low and high refrigerant pressure switches; short cycle control; outlet water temperature sensor and return water temperature sensor.

.9 The heat pump control shall provide for “Cascade” to sequence and rotate while maintaining operation of up to sixty-four heat pump modules. The heat pump shall be capable of controlling a valve and ECM variable speed pump that maintains constant delivery temperature to the storage tank. The heat pump shall have an optional gateway device which will allow integration with BACnet IP/MSTP and MODBUS RS485/TCP.

.10 The heat pump shall be equipped with terminal strips for electrical connection. A high voltage terminal strip shall be provided for Supply voltage. Supply voltage shall be 440-480V/3PH/60Hz. Optional field installed Voltage Transformer shall be offered by Manufacturer for additional voltages that shall be required.

.11 The heat pump Control Panel shall contain the low voltage connections for the outdoor sensor, system sensor, Alarm Contacts, Runtime Contacts, Back Up Enable contacts and Booster Fan contacts.

.12 The heat pump shall be suitable for use with polypropylene glycol, up to 50% concentration. The de-rate associated with the glycol will vary per glycol manufacturer.

.13 The heat pump shall be constructed in accordance with the code requirements as standard equipment.

.19 Instantaneous Water Heaters:

.1 Commercial Electric Instantaneous point-of-use Water Heater, Indoor model, WP, Rugged cast aluminum housing, Nichrome coil heating element, Temperature controlled by digital microprocessor, Field adjustable temperature, Disconnect switch, rotary 40A lockable NEMA 4X, ANSI A117.1 compliant, CALGreen® compliant, Certified to CSA C22.2 No. 88, Federal Public Law 111-380 (no lead), IAPMO compliant, Listed to UL STD 499.

3 Execution

3.1 INSTALLATION

.1 All gas equipment shall be installed to and meet CSA requirements.

.2 Temperature sensor shall be located in common supply header.

.3 Install sequence programmer panel remote from boilers and in accordance with the manufacturer's instructions.

.4 Install boiler on 100 mm (4") concrete base, with isolators. Furnish anchor bolts and setting diagrams to Work of Division 3 for correct setting in place.

.5 Co-ordinate heater control and panel as required for interconnecting with door switches provided by other trades.

.6 At time of start-up the manufacturer shall check the efficiency, instruct the Project Co. and provide a written report to the Contract Administrator/Engineer detailing all work undertaken.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 22 11 16 – Domestic water piping.

1.2 REFERENCE STANDARDS

.1 ANSI

.1 ANSI Z358.1-2014 Emergency Eyewash and Shower Standard

.2 ASTM

.1 ASTM C-564 Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.3 ASTM C1460 - 12 Standard Specification for Shielded Transition Couplings for Use With Dissimilar DWV Pipe and Fittings Above Ground. Canadian Standards Association (CSA International).

.1 CAN/CSA-B45 Series, Plumbing Fixtures.

.2 CAN/CSA-B125.3, Plumbing Fittings.

.3 CSA Standard B602-2010, Mechanical couplings for drain, waste, and vent pipe and sewer pipe

.4 CAN/CSA-B651, Accessible Design for the Built Environment.

.4 International Association of Plumbing and Mechanical Officials (IAPMO)

.5 National Plumbing Code of Canada

.6 National Building Code (NBC)

1.3 ACTIONS AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.3 Provide manufacturer's printed product literature and datasheets for fixtures and include product characteristics, performance criteria, physical size, finish and limitations.

.4 Closeout Submittals:

.5 Provide maintenance data in accordance with Section 01 78 00.

.6 Include:

.1 Description of fixture and trim, giving manufacturer's name, type, model, year, capacity.

.2 Details of operation, servicing, maintenance.

.3 List of recommended spare parts.

.7 Include diagrams for power, signal, and control wiring of automatic faucets.

.8 Refer to additional LEED requirements.

1.4 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.2 Separate waste materials for reuse and recycling.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material, in appropriate on-site bins.

.4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

2 Products

2.1 PLUMBING FIXTURE AND FITTING SCHEDULE

.1 For plumbing fixture and fitting manufacturers, catalogue numbers, and specific requirements, refer to the Drawing schedule of plumbing fixtures and fittings.

.2 Unless otherwise specified in the Contract Documents, requirements specified below apply to the plumbing fixtures and fittings scheduled on the Drawings.

2.2 GENERAL: PLUMBING FIXTURES AND FITTINGS

.1 Fixtures and fittings, where applicable, shall be in accordance with the requirements of CSA B45 Series, Plumbing Fixtures.

.2 All fixtures and fittings for use by the handicapped are to be in accordance with NBC requirements.

.3 Unless otherwise specified in the Contract Documents, all vitreous china and porcelain enamelled fixtures shall be white.

.4 Unless otherwise specified in the Contract Documents, all fittings exposed to view shall be chrome plated and polished.

.5 All fittings located in areas other than private washrooms shall be vandal-proof.

.6 All fixtures carriers shall be suitable in all respects for the fixture they support and the construction in which they are located.

2.3 ESH-1: COMBINATION EYEWASH AND SHOWER SAFETY STATION

.1 **Guardian G1902-DC-G3800LF-BC-HFC Emergency Equipment** - Floor mounted, constructed from Stainless Steel Bowl and ABS or Stainless Steel Showerhead, Stainless steel, 283 mm (11-1/8") Ø bowl size, Thermostatic mixing valve blends hot and cold water, Bowl Cover. Addn. for Stn. Steel Dust Cover that Covers Entire Stn. Steel Bowl, Orange ABS plastic showerhead, Two GS-Plus spray heads with flip top dust cover each, 25 mm (1") Ø I.P.S. chrome-plated brass stay-open ball valve, 13 mm (1/2") Ø I.P.S. chrome-plated brass stay open ball valve, 254 mm (10") diameter, 75 LPM (20 GPM) flow control, 32 mm (1-1/4") Ø NPT female top or side intlet supply inlet, Schedule 40, Furnished with orange polyethylene pipe, 32 mm (1-1/4") Ø NPT female outlet, GS Dust Cover. Addn. for Each Stn. Steel Dust Cover for GS-Plus™ Spray Head in Place of Plastic, Hand and Foot Control, Hand and Foot Control, Compliances and certifications:, ANSI compliant.

.2 **Watts FD-100NH-C-L-6 Floor Drain** - Epoxy coated cast iron, Floor drain, Adjustable Square 13 mm (1/2") thick reinforced top, No-hub outlet, Anchor flange, Reversible membrane clamp, Collar with primary and secondary weepholes, 58 cm² (9 sq. in.) free area (for 127 mm (5") diameter strainer), 77 cm² (12 sq. in.) free area (for 152 mm (6") diameter strainer), 168 cm² (26 sq. in.) free area (for 203 mm (8") diameter strainer), Vandal-proof, Compliances and certifications: ASME A112.21.1M compliant.

2.4 EW-1: EYE WASH WITH STAINLESS STEEL BOWL

.1 **Guardian G1814-DC-G3600LF-BC-HFC Emergency Equipment** - Wall-hung, Eye wash, constructed from Type 304 stainless steel construction, Thermostatic mixing valve blends hot and cold water, 283 mm (11-1/8") Ø bowl size, Corrosion resistant powder coated finish finish, Stainless steel bowl cover, Two GS-Plus spray heads with flip top dust cover each, 13 mm (1/2") Ø IPS Chrome plated brass stay open ball valve, 13 mm (1/2") Ø NPT female inlet supply inlet, 32 mm (1-1/4") Ø NPT female outlet, GS Dust Cover. Addn. for Each Stn. Steel Dust Cover for GS-Plus™ Spray Head in Place of Plastic, Hand and Foot Control, Hand and Foot Control, Compliances and certifications:, ANSI compliant.

2.5 KS-1: COUNTER MOUNTED – DROP IN – SINGLE BOWL KITCHEN SINK

.1 **Franke Commercial LBS6808P-1140G-1-3 Sink** - Single compartment sink, 203 mm (8") centerset, Commercial sinks, with overall dimension 508 mm (20") long, 521 mm (20-1/2") wide, 203 mm (8") high, constructed from 18 gauge Type 304 Stainless steel, Bowl dimensions are Left bowl is 457mm (18") long and right bowl is 305mm (12") long, 406 mm (16") wide, 203 mm (8") deep, Polished to #4 satin finish, Factory installed EZ TORQUE™ fasteners, Factory applied rim seal, Center back waste location, 38 mm x 76 mm (1-1/2" x 3") brass tailpiece, 1140G 89 mm (3 1/2") all metal basket strainer, Undercoated to reduce condensation and resonance, Compliances and certifications: ASME A112.19.3 compliant, CSA B45.4 compliant.

.2 **Chicago Faucets 431-ABCP Faucet** - Counter mounted, Manual, Single handle, Sink faucet, Polished chrome finish, 203 mm (8") centerset, Lead Free ANSI/NSF 61 compliant ECAST® brass construction, Ceramic cartridge, 5.7 LPM (1.5 GPM) maximum flowrate, Pressure compensating non-aerated laminar spray outlet, Fixed Tubular cast brass spout, 229 mm (9") spout reach, 152 mm (6") high, Lever handle, 13 mm (1/2") NPSM supply inlet.

.3 **McGuire LFBV170 Supply** - CONVERTIBLE™ Commercial Faucet Supply kit, consisting of (2) stop valves, (2) risers, (2) flanges (standard), Lead Free Brass body, Chrome-plated finish, 138 - 862 kPa (20 - 125 PSI) operating pressure, 4 to 60 °C (40 to 140 °F) operating temperature, Convertible loose key/triangle handle, Quarter turn ball valve, Angle stop, C.P. wrought steel deep bell wall flange (standard), C.P. prefabricated 127 mm (5") copper sweat tube extension nipple, 305 mm (12") C.P. lavatory flexible copper riser tubes (standard), 13 mm (1/2") Sweat inlet x 10 mm (3/8") O.D. outlet, 82 °C (180 °F) maximum during high-temperature system flush, AB 100 compliant, ASME A112.18.1 compliant, ASME A112.18.2-2 (risers), CSA B125.2 compliant (risers), Certified to NSF/ANSI 372, Certified to NSF/ANSI 61, UPC compliant.

.4 **McGuire 8912CB P-Trap** - Heavy cast brass, Adjustable P-Trap, 292 mm (11-1/2") length, With cleanout plug, Steel box flange, Neoprene gasket, Seamless tubular brass bend, Slipnuts

2.6 KS-2: COUNTER MOUNTED – DOUBLE BOWL KITCHEN SINK

.1 **Franke Kitchen Systems PS2X120-14-14 Sink** - Double compartment sink, Kitchen sink, with overall dimension 800 mm (31-1/2") long, 495 mm (19-1/2") wide, 254 mm (10") high, constructed from Type 304 Stainless steel, Left bowl is 356 mm (14") long and right bowl is 356 mm (14") long, Left bowl is 432 mm (17") wide and right bowl is 432 mm (17") wide, Left bowl is 254 mm (10") deep and right bowl is 254 mm (10") deep, Diamond finish, Round drain cover, 914 mm (36") minimum cabinet size.

.2 **Chicago Faucets 431-ABCP Faucet** - Counter mounted, Manual, Single handle, Sink faucet, Polished chrome finish, 203 mm (8") centerset, Lead Free ANSI/NSF 61 compliant ECAST® brass construction, Ceramic cartridge, 5.7 LPM (1.5 GPM) maximum flowrate, Pressure compensating non-aerated laminar spray outlet, Fixed Tubular cast brass spout, 229 mm (9") spout reach, 152 mm (6") high, Lever handle, 13 mm (1/2") NPSM supply inlet.

.3 **Lawler TMM-1070-87500 Mixing Valve** - The point of use mechanical mixing valve with thermostatic limit stop, MECHANICAL MIXING VALVE, Compression Fitting.

.4 **McGuire LFBV170 Supply** - CONVERTIBLE™ Commercial Faucet Supply kit, consisting of (2) stop valves, (2) risers, (2) flanges (standard), Lead Free Brass body, Chrome-plated finish, 138 -

862 kPa (20 - 125 PSI) operating pressure, 4 to 60 °C (40 to 140 °F) operating temperature, Convertible loose key/triangle handle, Quarter turn ball valve, Angle stop, C.P. wrought steel deep bell wall flange (standard), C.P. prefabricated 127 mm (5") copper sweat tube extension nipple, 305 mm (12") C.P. lavatory flexible copper riser tubes (standard), 13 mm (1/2") Sweat inlet x 10 mm (3/8") O.D. outlet, 82 °C (180 °F) maximum during high-temperature system flush, AB 100 compliant, ASME A112.18.1 compliant, ASME A112.18.2-2 (risers), CSA B125.2 compliant (risers), Certified to NSF/ANSI 372, Certified to NSF/ANSI 61, UPC compliant.

.5 **McGuire 8912CB P-Trap** - Heavy cast brass, Adjustable P-Trap, 292 mm (11-1/2") length, With cleanout plug, Steel box flange, Neoprene gasket, Seamless tubular brass bend, Slipnuts

2.7 JS-1: FLOOR MOUNTED – MOP SERVICE SINK

.1 **Stern Williams SB-900-T-35-T-40-BP Sink** - Single compartment sink, Mop service sinks, with overall dimension 610 mm (24") long, 610 mm (24") wide, 305 mm (12") high, constructed from Precast terrazzo, Bowl dimensions are 546 mm (21-1/2") long, 546 mm (21-1/2") wide, 254 mm (10") deep, Pearl grey marble chips and white portland cement, 76 mm (3") pipe size, cast integrally and provides for a caulked lead connection not less than 25 mm (1") deep to a 76 mm (3") pipe, flat stainless steel strainer, Without tiling flange, With stainless steel cap, Hose and wall hook, Mop hanger, Splash catcher.

.2 **Chicago Faucets 897-RCF Faucet** - Wall-hung, Manual, Two handles, Mop sink faucet, Rough chrome plated finish, 194 - 213 mm (7-5/8" to 8-3/8") adjustable centerset, Round wall escutcheons, Brass construction, Adjustable supply arms, 1/4 turn ceramic cartridge, No flow restrictor, Threaded hose end, Fixed Spout with pail hook, 146 mm (5-3/4") spout reach, 273 mm (10-3/4") high, Top brace, 60 mm (2-3/8") lever handle with indexed buttons, Atmospheric vacuum breaker is not intended for continuous pressure applications.

.3 **Lawler TMM-1070-87500 Mixing Valve** - The point of use mechanical mixing valve with thermostatic limit stop, MECHANICAL MIXING VALVE, Compression Fitting.

2.8 L-1: LAVATORY

.1 **American Standard 0955001EC.020 0059020EC.020 Basin** - MURRO, Wall-hung Lavatory, Vitreous china, EverClean® antimicrobial surface, White finish, Single hole centerset, Rear overflow, Faucet ledge with recessed self-draining deck, For concealed arm or wall support, Vitreous china shroud/knee contact guard with EverClean (0059020EC), Soap dispenser, When installed with a below deck electronics faucet which has the control box, the accessories will not fit under the shroud and will need to be installed outside the shroud, Overall Dimensions: 545 mm (21-7/16") long, 540 mm (21-1/4") wide, 152 mm (6") high, Bowl Dimensions: 343 mm (13-1/2") long, 394mm (15-1/2") wide, 127 mm (5") deep.

.2 **American Standard 7755303.002 Faucet** - NEXTGEN SELECTRONIC, Counter mounted, Automatic no-touch, CR-P2 lithium battery installed in faucet, Lavatory faucet, Polished chrome finish, Single hole centerset, Lead Free ANSI/NSF 61 and ANSI/NSF 372 compliant Vandal-resistant metal body, Pre-installed 610 mm (24") flexible stainless steel inlet hose with integral strainer and 10 mm (3/8") compression fitting, 1.3 LPM (0.35 GPM) maximum flowrate, Vandal-resistant pressure compensating multi-laminar spray outlet, Fixed Fixed spout, 125 mm (4-7/8") spout reach, 146 mm (5-3/4") high, Programmable sensor, Electronically operated self-cleaning solenoid valve with chemical silicon seals, Single inlet for cold or tempered water, Integral thermostatic hot water temperature limiter (meets ASSE 1070 without a separate thermostatic mixing valve), Remote control adjusts setup parameters and allows for customization of functions.

.3 **McGuire 155A Fixture Drain** - Straight drain, Cast brass, Chrome-plated finish, Open grid PO plug, 7/32" (5.5 mm) Ø holes size, 17 gauge 32 mm (1-1/4") Ø tailpiece, 17 gauge 152 mm (6") long, Brass locknut, Heavy rubber basin washer Fiber friction washer, ASME A112.18.2 CSA B125.2, CSA compliant

.4 **McGuire LFH170LKR15 Supply** - HEAVY PREMIERE Line Heavy pattern Faucet Supply kit, consisting of (2) stop valves, (2) risers, (2) flanges (standard), Lead Free Brass body, Chrome-

plated finish, 138 - 862 kPa (20 - 125 PSI) operating pressure, 4 to 60 °C (40 to 140 °F) operating temperature, Loose key handle, Full turn, Angle stop, C.P. wrought steel deep bell wall flange (standard), C.P. prefabricated 127 mm (5") copper sweat tube extension nipple, 381 mm (15") C.P. lavatory flexible copper riser tube, 13 mm (1/2") Sweat inlet x 10 mm (3/8") O.D. outlet, AB 100 compliant, ASME A112.18.1 compliant, ASME A112.18.2-2 (risers), CSA B125.2 compliant (risers), Certified to NSF/ANSI 372, Certified to NSF/ANSI 61, UPC compliant.

.5 **McGuire 8872C P-Trap** - Heavy cast brass, Adjustable P-Trap, 292 mm (11-1/2") distance, With cleanout plug, Steel shallow flange, Neoprene gasket, Slipnuts, 17 gauge seamless tubular wall bend, ASME A112.18.2 CSA B125.2, CSA compliant

.6 **Watts WCA-411-CA-481 Carrier** - WCA-411/WCA-411-WC, Lavatory carrier, Single floor-mounted lavatory carrier with concealed arms, For concealed arm carrier, adjustable arms, epoxy coated cast iron, integral welded feet, upper tie rod, Heavy gauge steel offset uprights, basin locking device, Plated hardware, levelling screws, Wall mounted steel support plate with plated hardware.

2.9 L-2: LAVATORY

.1 **American Standard 9495001.020 Basin** - CADET UNIVERSAL ACCESS, Drop-in Lavatory, Vitreous china, White finish, Single hole centerset, Two (2) rear overflow holes, With faucet ledge, Overall Dimensions: 533 mm (21") long, 445 mm (17-1/2") wide, 165 mm (6-1/2") high, Bowl Dimensions: 441 mm (17-3/8") long, 279 mm (11") wide, 133 mm (5-1/4") deep.

.2 **American Standard 7755303.002 Faucet** - NEXTGEN SELECTRONIC, Counter mounted, Automatic no-touch, CR-P2 lithium battery installed in faucet, Lavatory faucet, Polished chrome finish, Single hole centerset, Lead Free ANSI/NSF 61 and ANSI/NSF 372 compliant Vandal-resistant metal body, Pre-installed 610 mm (24") flexible stainless steel inlet hose with integral strainer and 10 mm (3/8") compression fitting, 1.3 LPM (0.35 GPM) maximum flowrate, Vandal-resistant pressure compensating multi-laminar spray outlet, Fixed Fixed spout, 125 mm (4-7/8") spout reach, 146 mm (5-3/4") high, Programmable sensor, Electronically operated self-cleaning solenoid valve with chemical silicon seals, Single inlet for cold or tempered water, Integral thermostatic hot water temperature limiter (meets ASSE 1070 without a separate thermostatic mixing valve), Remote control adjusts setup parameters and allows for customization of functions.

.3 **McGuire 155A Fixture Drain** - Straight drain, Cast brass, Chrome-plated finish, Open grid PO plug, 7/32" (5.5 mm) Ø holes size, 17 gauge 32 mm (1-1/4") Ø tailpiece, 17 gauge 152 mm (6") long, Brass locknut, Heavy rubber basin washer Fiber friction washer, ASME A112.18.2 CSA B125.2, CSA compliant

2.10 L-3: WASH FOUNTAIN

.1 **Bradley Corp® Wash Fountain, Semi-Circular, 110/24 VAC, Series SN202, 4 Person – Sensor operated –** ADA Compliant, Sentry (TM) Stainless Steel Wash fountains Low-water consumption wash fountains with individually activated sprayheads. Include 1 set of water supply and waste connections for fast installation and easy maintenance. 1/2" supply and 1 1/2" drain connections Flow rate: 0.5 GPM

2.11 SH-1: COLONY® PRO WATER-SAVING PRESSURE BALANCE BATH/SHOWER TRIM

.1 **American Standard TU075507.002 Complete Shower Trim** - Water-Saving pressure Balance bath/Shower trim with double ceramic pressure Balance Cartridge, Polished chrome finish, Shower Trim kit with water-saving showerhead with a maximum 1.75 GPM (6.6 LPM) flowrate, less valve body, 1.75 GPM (6.6 LPM) maximum flowrate {when selected as bath/shower trim kit or shower trim kit}, Metal wall valve trim with RED/BLUE indicator ring, Metal lever handle, Pressure Balance, Includes integrated check valves, Diverting tub spout, For use with Flash™ rough valve Bodies, Cycles from in off" to in cold" to in hot", Double ceramic pressure Balance Cartridge, Washerless ceramic discs provide smooth handle movement and are unaffected by harsh water conditions, Ceramic balancing spool maintains constant output temperature in response to changes in relative hot and cold supply pressure, Hot limit safety stop, ASSE 1016, ASME A112.18.1016, CSA B125.16, ASME A112.18.1, CSA B125.1

.2 **American Standard RU101 Shower Valve** - FLASH™, Cast brass construction, Shower valve, Pressure Balance rough valve body only, less trim, One-half" inlets and outlets, Universal inlets/outlets, With a pre-installed test cap with stainless steel retaining ring with flats, Features back-to-back capability, Flat back to Allows valve to be mounted flush against cross brace for easy and solid installation, Rough-in plaster guard designed as rough-in guide and for use as thin wall mounting support., ASSE 1016, ASME A112.18.1016, CSA B125.16, ASME A112.18.1, CSA B125.1, To avoid shower rise or other related issues, do not use pex connections on any of the outlets, For use with TU series trim kits with cartridges

2.12 SH-2: MODERN 5-FUNCTION HAND

.1 **American Standard 1660.637.002 Hand Shower** - Hand shower, Polished chrome finish, 2.5 GPM (9.5LPM) maximum flowrate, Spray pattern adjusts from full spray to full/massage combination (1) to pulsating massage to massage/mist combination (2) to power mist, Includes check valve to prevent cross flow of hot and cold water, Easy clean spray nozzles, ASME A112.18.1, CSA 125.1

.2 **American Standard 1660236.002 Slide Bar** - Standard, SLIDE BAR, Polished chrome finish, 2-1/2" wide, 600 - 899 mm (23-5/8" - 35-3/8") high, 36"

.3 **American Standard 8888.037.002 Wall Supply** - WALL SUPPLY, Polished chrome finish, Includes check valve, 1/2" NPT female thread, 1/2" NPSM male hose thread

.4 **American Standard 8888.036.002 Hand Shower Holder** - FIXTURE WALL BRACKET, Polished chrome finish

.5 **American Standard 1660.400.002 Vacuum Breaker** - Vacuum breaker, Polished chrome finish for Inline with 13 mm (1/2") size, Attaches between supply outlet and personal shower hose.

2.13 UR-1: WALL-HUNG – TOP SPUD – FLUSH VALVE URINAL

.1 **American Standard 6590001EC.020 Urinal** - WASHBROOK® FLOWISE®, Vitreous china, White finish, Permanent EverClean surface inhibits the growth of stain and odor causing bacteria, Wall-hung, Urinal operates in the range of 0.5 to 3.8 LPF (0.125 - 1.0 GPF), Washdown flush action, 51 mm (2") NPT female outlet, Chrome-plated non-metallic strainer, 19 mm (3/4") spud connection, Top spud, Compliances and certifications: EPA WaterSense® certified, CSA B45.4-08 compliant, ANSI A117.1 compliant, ASME A112.19.2 compliant.

.2 **Sloan SL-ECOS-186-0.13-OR-HW Flush Valve** - ECOS® Automatic no-touch Exposed Urinal flushometer, High Efficiency 0.5 LPF (0.125 GPF), 19 mm (3/4") spud coupling For top spud urinal, Hardwired, constructed from Semi-red brass, Polished chrome finish, Chloramine resistant PERMEX® synthetic rubber diaphragm, Smart Sense Technology™ self-adaptive infrared sensor, Sensor located on engineered metal cover with replaceable lens window, Courtesy Flush® electrical override button, Flush tube for 292 mm (11-1/2") rough-in, 19 mm (3/4") I.P.S. screwdriver Bak-Chek® angle control stop with vandal-resistant stop cap, Sweat solder adapter kit with cover tube, High back pressure vacuum breaker, 19 mm (3/4") supply pipe, Cast wall flange with set screw, 6 VAC, cUPC compliant.

.3 **Watts CA-321 Carrier** - epoxy coated, Urinal Carrier, Floor Mounted Urinal Carrier with Bearing Plate, Wall Plate, welded feet, Universal steel hangar support plate, bottom bearing plate, Heavy gauge steel offset uprights, integral mounting brackets, Plated hardware.

.4 **Watts WUCO-4 Cleanout** - Non-adjustable Line cleanout, Stainless steel cover Two-piece expandable cleanout plug for urinal, 102 mm (4") plug size.

.5 **Mission NO HUB Series Coupling** - shielded No-hub (MJ) coupling, For non-pressure gravity flow applications only, Recommended for above ground installations, (2 or 4) Type 301 stainless steel worm drive clamps, Type 301 corrugated stainless steel shield, One-piece molded elastomeric sealing gasket, Tightened to 69 kg.cm (60 in-lb) max. torque, Stainless steel conforms to ASTM A240/A240M, Meets & exceeds performance standard ASTM C1277, Rubber conforms to ASTM C564, Meets or exceeds all CISPI® 310 specifications, Conforms to CSA CLASS 7021 (B602), IAPMO FILE 0743 listed.

2.14 WC-1: COMBINATION TOILET AND FLUSH VALVE – WALL HUNG – AUTOMATION NO TOUCH

.1 **American Standard 3351511.020 Toilet** - AFWALL® MILLENIUM™ FloWise®, Combination toilet and flush valve, Wall-hung with wall outlet, Toilet operates in the range of 4.2 to 6.0 LPF (1.1 - 1.6 GPF), Vitreous china, White finish, EverClean® antimicrobial surface, Elongated bowl, Direct-fed siphon jet flush action, 38 mm (1-1/2") top spud, Complete with 6065111.002 Ultima™ Selectronic™ electronic exposed flushometer (battery powered, Ultra High Efficiency UHET 4.2 LPF (1.1 GPF), piston-type, polished chrome finish), 254 x 305 mm (10" x 12") water surface area, Fully-glazed 54 mm (2-1/8") trapway, Condensation channel, Toilet seat not included, Bolt caps not included, 356 mm (14") wide, 660 mm (26") from finished wall, ASME A112.19.2 compliant, CSA B45.1 compliant.

.2 **American Standard 5901110T.020 Seat** - COMMERCIAL Heavy-duty Open front Toilet seat Without cover, For elongated bowl, White, Polypropylene plastic, EverClean® antimicrobial surface, External color-matched plastic check hinges with stainless steel posts, preventing the seat from exceeding 11° beyond vertical, Installed from the bottom of the bowl, Large molded-in bumpers.

.3 **Mission NO HUB Series Coupling** - shielded No-hub (MJ) coupling, For non-pressure gravity flow applications only, Recommended for above ground installations, (2 or 4) Type 301 stainless steel worm drive clamps, Type 301 corrugated stainless steel shield, One-piece molded elastomeric sealing gasket, Tightened to 69 kg.cm (60 in-lb) max. torque, Stainless steel conforms to ASTM A240/A240M, Meets & exceeds performance standard ASTM C1277, Rubber conforms to ASTM C564, Meets or exceeds all CISPI® 310 specifications, Conforms to CSA CLASS 7021 (B602), IAPMO FILE 0743 listed.

2.15 WC-2: COMBINATION TOILET AND FLUSH VALVE – WALL HUNG – AUTOMATION NO TOUCH

.1 **American Standard 3351511.020 Toilet** - AFWALL® MILLENIUM™ FloWise®, Combination toilet and flush valve, Wall-hung with wall outlet, Toilet operates in the range of 4.2 to 6.0 LPF (1.1 - 1.6 GPF), Vitreous china, White finish, EverClean® antimicrobial surface, Elongated bowl, Direct-fed siphon jet flush action, 38 mm (1-1/2") top spud, Complete with 6065111.002 Ultima™ Selectronic™ electronic exposed flushometer (battery powered, Ultra High Efficiency UHET 4.2 LPF (1.1 GPF), piston-type, polished chrome finish), 254 x 305 mm (10" x 12") water surface area, Fully-glazed 54 mm (2-1/8") trapway, Condensation channel, Toilet seat not included, Bolt caps not included, 356 mm (14") wide, 660 mm (26") from finished wall, ASME A112.19.2 compliant, CSA B45.1 compliant.

.2 **American Standard 5901110T.020 Seat** - COMMERCIAL Heavy-duty Open front Toilet seat Without cover, For elongated bowl, White, Polypropylene plastic, EverClean® antimicrobial surface, External color-matched plastic check hinges with stainless steel posts, preventing the seat from exceeding 11° beyond vertical, Installed from the bottom of the bowl, Large molded-in bumpers.

.3 **Sloan ECOS 111-1.1-OR-HW Flush Valve** - ECOS® Automatic no-touch Exposed Water closet flushometer, Ultra High Efficiency 4.2 LPF (1.1 GPF), 38 mm (1-1/2") spud coupling For top spud toilet, Hardwired, constructed from Semi-red brass, Polished chrome finish, Chloramine resistant PERMEX® synthetic rubber diaphragm, Smart Sense Technology™ self-adaptive infrared sensor, Sensor located on engineered metal cover with replaceable lens window, Courtesy Flush® electrical override button, Flush tube for 292 mm (11-1/2") rough-in, 25 mm (1") I.P.S. screwdriver Bak-Chek® angle control stop with free spinning vandal-resistant stop cap, Twin linear filtered bypass and vortex cleansing action, Sweat solder adapter kit with cover tube, High back pressure vacuum breaker, 25 mm (1") supply pipe, Cast wall flange with set screw, No external volume adjustment, 6 VAC step down transformer, includes standard 18" electrical cable, 103 - 552 kPa (15 - 80 PSI) operating water pressure, cUPC compliant.

.4 **Franke Commercial CM-16104-WM Backrest** - wall mounting, back rest, solid core plastic laminate panel back, Antique white, 305 mm (12") wide, 102 mm (4") high, 137 mm (5-3/8"), 18 gauge stainless steel bar with #4 gloss with flanges and covers, concealed snap flanges and mounting hardware included, Provide adequate backing in wall for support and comply to local codes for barrier free requirements

2.16 CARRIER 1: INDUSTRY STANDARD SINGLE HORIZONTAL ADJUSTABLE CLOSET CARRIER

.1 **Watts ISCA-101-L/R-M20 Carrier** - Closet Carrier, Industry Standard single Horizontal adjustable Closet Carrier, Adjustable for standard and wheelchair height, 102 mm (4") no hub waste, 51 mm (2") no hub vent connections, patented compression seal faceplate assembly, epoxy coated cast iron, with incremental measurements embossed onto legs to easily adjust height of carrier to most commonly used fixture requirements, epoxy coated cast iron foot support, neoprene bowl gasket, epoxy coated cast iron, integral test cap, chrome cap nuts, Plated hardware, Adjustable ABS nipple, Flush valve support, Compliances and certifications: Carrier complies with requirements of ASME A112.6.1M up to a 500 lb (227 kg) static load.

2.17 CARRIER 2: INDUSTRY STANDARD BACK-TO-BACK HORIZONTAL ADJUSTABLE CLOSET CARRIER - - 500 LB (227 KG)

.1 **Watts ISCA-101-D-M20 Carrier** - Horizontal, Closet Carrier, Industry Standard Back-to-Back Horizontal adjustable Closet Carrier, 500 lb (227 kg), Adjustable for standard and wheelchair height, 102 mm (4") no hub waste, 51 mm (2") no hub vent connections, patented compression seal faceplate assembly, epoxy coated cast iron, with incremental measurements embossed onto legs to easily adjust height of carrier to most commonly used fixture requirements, epoxy coated cast iron foot support, neoprene bowl gasket, epoxy coated cast iron, integral test cap, chrome cap nuts, Plated hardware, Adjustable ABS nipple, Flush valve support, Compliances and certifications: Carrier complies with requirements of ASME A112.6.1M up to a 500 lb (227 kg) static load.

2.18 DF-1: WALL MOUNTED (ON WALL) - SURFACE INSTALLATION - DUAL HEIGHT DRINKING FOUNTAIN WITH BOTTLE FILLER AND CHILLER

.1 Haws model 1011 ADA Dual Vandal-Resistant Drinking Fountain - Model 1011 Hi-Lo wall mounted barrier-free vandal-resistant drinking fountain shall include dual 18 gauge Type 304 Stainless Steel satin finish basins with integral swirl design, 14 gauge Type 304 Stainless Steel wall bracket, 100% lead-free waterways, vandal-resistant push-button operated stainless steel valves with front-accessible cartridge and flow adjustment, polished chrome-plated brass vandal-resistant bubbler heads with integral laminar anti-squirt flow, chrome plated brass vandal-resistant waste strainers, vandal-resistant bottom plates, stainless steel satin finish back panel, high and low fountain mounting levels, and 1-1/4″ O.D. (3.2 cm) waste pipes. (P-trap and stop require rear access)

.2 Model 6700.4 ‘Hi-Lo’ in-wall 3/16″ thick steel pre-drilled mounting shall include the all-thread studs, nuts, and washers. For use with Haws dual bubbler fountains.

.3 Support Frame: Model 6800 In-wall floor mounted fixture support legs, welded steel 4-bolt floor flanges, and supplied with ‘U’ bolts and hardware.

.4 Access Panel: Model 6603, satin finish stainless steel access panel. Includes frame and screws.

.5 McGuire LFHST01LK Stop Valves - Convertible loose key handle, Lead Free, Chrome-plated finish, 3/8" I.P.S x 3/8" O.D

.6 McGuire 8872C P-Trap - Heavy cast brass, Adjustable P-Trap, 292 mm (11-1/2") distance, With cleanout plug, Steel shallow flange, Neoprene gasket, Slipnuts, 17 gauge seamless tubular wall bend, ASME A112.18.2 CSA B125.2, CSA compliant

2.19 ACCEPTABLE MANUFACTURERS

.1 **Vitreous china and enameled cast iron or steel fixtures:** Zurn, Sloan, American Standard, Toto, and Kohler.

.2 **Stainless steel sinks:** Franke, AERO, Novanni Stainless Inc., Kindred Industries "Aristaline”.

.3 **Precast terrazzo fixtures:** Acorn, Fiat Products Ltd. and Stern-Williams.

.4 **Water closet seats:** Zurn, Bemis, Centoco, Olsonite and Beneke

.5 **Flush valves:** Zurn, Delta Commercial, Sloan, Toto

.6 **Fixture carriers:** Zurn, Mifab, Jay R. Smith and Watts Industries

.7 **Faucets:** unless otherwise specified, Zurn, Delta Commercial, American Standard, Kohler and Chicago Faucet

.8 **Fixture trim:** unless otherwise specified, McGuire, Zurn, American Standard , Kohler

.9 **Water mixing valves and associated trim:** Powers, Zurn, Crane, Symmons, American Standard, Bradley and Kohler

.10 **Shower valves:** American Standard, Moen, Kohler, Delta Commercial, Grohe

.11 **Floor drains:** Watts Industries, Zurn, Mifab, Jay R. Smith

.12 **Emergency Fixtures:** Haws, Bradley, Guardian, Hughes Safety Showers

3 Execution

3.1 INSTALLATION OF PLUMBING FIXTURES AND FITTINGS

.1 Provide all required plumbing fixtures and fittings.

.2 Provide isolation valves (ball valves) for all fixtures.

.3 Connect plumbing fixtures and fittings with piping sized in accordance with the Drawing schedule.

.4 Confirm the exact location of all plumbing fixtures and trim prior to roughing-in.

.1 Lavatory/Sink Rough-ins: The contractor shall provide evenly spaced water lines at a uniform height above the drain fitting (or elsewise indicated by the manufacturer installation instructions). Contractor shall use either conventional pipe hangers/supports as specified in Section 20 05 29 - Hanger and Supports or non-combustible, dielectrically isolated pipe guides (equivalent to IPEX System XFR Water Line Guide) as practicable/applicable.

.2 Flush Valve Rough-ins: The contractor shall provide a water line as required above the drain fitting (or elsewise indicated by the manufacturer installation instructions). Contractor shall use either conventional pipe hangers/supports as specified in Section 20 05 29 - Hanger and Supports or non-combustible, dielectrically isolated pipe supports on fixture carriers (equivalent to HOLDRITE #114-C) as practicable/applicable.

.3 Rough-ins For Other Fixtures: Contractor shall use conventional pipe hangers/supports as specified in Section 20 05 29 - Hanger and Supports. Refer to manufacturer installation instructions

.5 When installation is complete, check and test the operation of each fixture and fitting. Adjust or repair as required.

.6 **Counter Mounted Fixtures and Trim:** Supply templates for all counter mounted fixtures and trim and hand to the trade who will buy the counter. Ensure openings in the counter are properly located.

.7 **Electronic Lavatory Faucets:** Locate control panels for electronic faucets under the lavatories and recessed into the wall. It is the intent to locate the transformer(s) (power converter(s)) in the wall cavity or concealed under counters. Provide access doors accordingly for servicing of transformer(s). Coordinate locations with the work of Division 26 that will provide 120 vac line supply to the transformers(s). Provide low voltage wiring from the transformer(s) to each terminal point in control panel(s) under lavatories. All water and electronic supply from control panel to faucet shall be through the flexible conduit supplied with the control panel. Connect hot and cold water piping to the mixing valve in each box, and tempered water piping from each mixing valve to the faucet. Set mixing valve maximum temperature limit stops to 43ºC. (109ºF) after potable water systems (hot and cold) are complete. Ensure that each programmable controller is properly programmed, and that water off after deactivation is set for three seconds. **Note:** All electrical line supply and low voltage wiring, including any wall receptacles as well as low voltage wiring to boxes shall be concealed.

.8 **Electronic Flush Valves:** Locate the transformer(s) (power converter(s)) in the wall cavity next to fixtures to be served. Provide access doors accordingly for servicing of transformer(s). Coordinate locations with Division 26 who will provide 120 vac line supply to the transformers(s). Provide low voltage wiring from the transformers(s) to each electronic flush valve terminal point. Note: All electrical line supply and low voltage wiring, including any wall receptacles as well as low voltage wiring to boxes shall be concealed.

.9 **Thermostatic Mixing Valves:** The device shall be designed to be installed at a single outlet. It may be used to supply individual outlets when there is sufficient supply pressure. Ball valves shall be installed on the hot and cold inlet supplies. Temperature shall be field set. Maximum pressure differential shall be 103 kPa (15 psi) between hot and cold inlets. Integral check valves and strainer screen shall be installed on hot and cold supply.

.10 **Shower Fittings:** Confirm exact mixing valve and shower head locations with the Contract Administrator prior to roughing-in.

3.2 ADJUSTING

.1 Adjust the water flow rate to design flow rates.

.2 Adjust the pressure to fixtures to ensure no splashing at maximum pressures.

.3 Checks:

.1 Aerators: Verify operation, cleanliness.

.2 Vacuum breakers, backflow preventers: Verify operation under all conditions.

.3 Thermostatic controls:

.4 Verify temperature settings, operation of control, limit and safety controls.

3.3 CLEANING AND PROTECTION

.1 After completing the installation of fixtures, inspect and repair damaged finishes.

.2 Clean fixtures, faucets, valves and other fittings with the manufacturers' recommended cleaning methods and materials.

.3 Provide protective covering for installed fixtures and fittings.

.4 Do not allow the use of fixtures for temporary facilities unless approved in writing by the Project Co. and City.

END OF SECTION

1 General

1.1 REFERENCE

.1 Division 00 and Division 01 apply to and are a part of each Electrical Division Section.

1.2 APPLICATION

.1 This Section specifies products, criteria and characteristics, and methods and execution that are common to one or more Sections of Electrical Divisions. It is intended as a supplement to each Section of Electrical Divisions and is to be read accordingly.

.2 Be responsible for advising product vendors of requirements of this Section.

1.3 SUBMITTALS

.1 Submit shop drawings for products of this Section.

.2 Additionally, as part of shop drawing submission process, submit following to Contract Administrator for review:

.1 sample of each proposed type of access door if supplied under work of this Division, as well as electronic copies of reflected ceiling plan drawings and wall elevation drawings showing proposed access door locations;

.2 dimensioned location drawings indicating required sleeves and formed openings in structural poured concrete or precast concrete construction or in roofing, and locations of cutting or drilling required for Electrical Divisions work;

.3 samples of materials and any other items as specified in succeeding Sections of Electrical Divisions;

.4 weight loads of selected equipment (upon request);

.5 equipment nameplate and warning sign proposed nomenclature, print type, symbols, sizing and colours;

.6 fire stopping installation drawings with ULC certifications;

.7 copies of prior to start of construction approvals from local governing authorities having jurisdiction.

.3 Prior to application for Substantial Performance of the Work, submit following to Contract Administrator for review (note: funds will be withheld until each of following items have been completed and documented to satisfaction of City and reviewed with Contract Administrator):

.1 fire alarm system testing and verification report of each component of work; devices to be certified working and in proper order;

.2 final distribution system testing and arc flash study performed and documented to satisfaction of Contract Administrator;

.3 structured network cabling system tested and verified to be operating and performing in accordance with specified standards.

1 General

1.1 SUMMARY

.1 Related Documents:

.1 Drawings and general provisions of the Contract including General and Supplementary conditions and all Division Specifications Sections, apply to this Section.

.2 This section covers the Contractor's responsibility for commissioning; each subcontractor or installer responsible for installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item

.3 Review these documents for coordination with additional requirements and information that apply to work under this Section.

.2 Section Includes:

.1 General requirements that apply to implementation of commissioning of HVAC systems, assemblies and components.

.2 The Commissioning Authority (CxA) will direct and coordinate all commissioning activities with the assistance of the Contractor; the CxA will provide the prefunctional checklists similar to samples included within this spec section and the functional test plans for the Contractor's usage. Refer to section 01 91 00 for General Commissioning Requirements and CxA Responsibilities.

.3 Related Sections:

.1 Division 01 Section General Requirements

.1 Section 01 70 00 Examination and Preparation

.2 Section 01 79 00 Demonstration and Training

.3 Section 01 91 00 General Commissioning Requirements

.2 Division 22: Plumbing

.3 22 08 00 Commissioning of Plumbing

.4 Division 23: HVAC, HVAC Controls, Testing and Balancing, and Air Distribution

.5 23 08 00 Commissioning of HVAC

.6 Division 25: Integrated Automation

.7 Division 26: Electrical

.8 26 08 00 Commissioning of Electrical

1.2 REFERENCES

.1 General:

.1 The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

.2 Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

.3 Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

.4 Refer to Division 25 Section "Common Work Results for Integrated Automation" for codes and standards, and other general requirements.

.2 Standards

.1 ASHRAE Guideline 13 - SPECIFYING BUILDING AUTOMATION SYSTEMS

.2 ASHRAE Guideline 36 - HIGH-PERFORMANCE SEQUENCES OF OPERATION FOR HVAC SYSTEMS

.3 ASHRAE Guideline 0 – The Commissioning Process, 2013

.4 ASHRAE Guideline 1.1 – The HVAC&R Technical Requirements for the Commissioning Process, 2012

.5 ASHRAE Standard 202 - Commissioning Process for Building and Systems, 2013

.6 CSA Z320-11 – Building Commissioning

.7 CaGBC LEED V4 BD+C

1.3 DESCRIPTION

.1 The purpose of commissioning is to ensure the City that work has been completed as specified and that systems are functioning in the manner as described in Division 25 Section "Common Work Results for Integrated Automation" and specified system operating criteria. It will assist operating staff training and familiarization with new systems. It will serve as a quality assurance program to reduce post-occupancy critical systems operational difficulty or failure. It will, also, be used to develop test protocol and record the associated test data in an effort to advance the building systems from a state of substantial completion to a full dynamic operation.

.2 Commissioning will commence after startup of equipment and systems have been confirmed as under power and under control and balancing of air and water systems have been completed. All relevant tie-ins of the equipment systems are to be completed to demonstrate whole building systems operation.

.3 Commissioning work shall include, but not be limited to:

.1 Attendance at all Commissioning Meetings.

.2 Preparation of Commissioning Plan.

.3 Preparation of Commissioning Schedule.

.4 Development and completion of Commissioning Report forms and check sheets for each system and piece of equipment.

.5 Demonstration to the City and Contract Administrator(s) that the equipment/system have been installed per contract documents.

.6 Preparation of O&M Manual.

.7 Preparation of Record Drawings.

.8 Start-up and verification of systems and equipment.

.9 Performance testing of equipment.

.10 Review and verification of Testing, Adjusting and Balancing work and report.

.11 Correction of all deficiencies and performance deviations.

.12 Demonstration and training to the City and Contract Administrator of all systems and equipment provided in this Division.

.13 Preparation and assembly of Commissioning Documentation.

.14 Coordination of Division 23 - HVAC commissioning activities with all other trades.

.15 Coordinate with and assist Division 21 - Fire Suppression, Division 22 - Plumbing, and 26 - Electrical for Commissioning of their respective works.

.4 The milestones associated with commissioning are outlined below:

.1 Installation Verification

.2 Point to Point Verification

.3 System Start-Up.

.4 Functional Performance Testing.

.5 Issues Review and Retesting

.6 Operations and Maintenance Manual Review

.7 Building Operations Demonstration and Training

.8 Seasonal Testing and Warranty Review (as required)

.5 Operational staff training is essential to the commission process and will run concurrently with the commissioning milestones listed above.

.6 The Commissioning Team will include representatives of the City, Contract Administrator, Construction and Installing Subcontractors, Test and Balance Subcontractor, BAS Subcontractor and Construction Subcontractor's Commissioning Agent. Equipment manufacturer's representatives will be present for start-up as specified in the equipment specification sections and for equipment training.

1.4 SYSTEMS TO BE COMMISSIONED

.1 Commissioning will be performed on the following systems:

.1 Integrated Automation Network Equipment:

.1 Integrated Automation Network Devices

.2 Integrated Automation Network Gateways

.3 Integrated Automation Control and Monitoring Network

.4 Integrated Automation Local Control Units

.5 Integrated Automation Software

.2 Integrated Automation Instrumentation and Terminal Devices

.1 Integrated Automation Instrumentation and Terminal Devices for Facility Equipment

.2 Integrated Automation Instrumentation and Terminal Devices for Plumbing

.3 Integrated Automation Instrumentation and Terminal Devices for HVAC

.4 Integrated Automation Instrumentation and Terminal Devices for Electrical Systems

.3 Integrated Automation Facility Controls

.4 Integrated Automation Control Sequences

1.5 SUBMITTALS

.1 See Section 01 91 00 - General Requirements, for submittal procedures. Construction Schedule with Commissioning Milestones

.2 Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

.3 Start up and testing procedures

.4 Calibration certifications of all testing equipment to be used during functional testing period

.5 Equipment Factory Acceptance Tests

.6 Start-Up Reports including but not limited to Manufacturer Start-Up Reports, prefunctional checklists, pressure and leakage tests, BAS point to point verification reports and graphics and TAB reports for CxA Approval and Review.

.7 Method of Procedures as required for any required shut-downs for testing

.8 Training Requirements, agenda, and schedule

.9 Draft Training Plan: In addition to requirements specified in Section 01 79 00, include:

.1 Follow the recommendations of ASHRAE Guideline 1.

.2 Control system manufacturer's recommended training.

.3 Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.

.10 Training Manuals: See Section 01 79 00 for additional requirements.

.11 Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

.12 Operations and Maintenance Manuals

.1 HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:

.2 Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.

.3 Full as-built set of control drawings.

.4 Full as-built sequence of operations for each piece of equipment.

.5 Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:

.1 Floor.

.2 Room number.

.3 Room name.

.4 Air handler unit ID.

.5 Reference drawing number.

.6 Full print out of all schedules and set points after testing and acceptance of the system.

.6 Full as-built print out of software program.

.7 Electronic copy on disk of the entire program for this facility.

.8 Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.

.9 Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.

.10 Control equipment component submittals, parts lists, etc.

.11 Warranty requirements.

.12 Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).

.13 Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:

.1 Sequences of operation.

.2 Control drawings.

.3 Points lists.

.4 Controller and/or module data.

.5 Thermostats and timers.

.6 Sensors and DP switches.

.7 Valves and valve actuators.

.8 Dampers and damper actuators.

.9 Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.

.10 Program setups (software program printouts).

2 Products

2.1 COMMISSIONING PLAN

.1 The commissioning plan shall outline the organization, scheduling, team members, and documentation pertaining to the overall commissioning process.

2.2 PREFUNCTIONAL CHECKLISTS

.1 Draft Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:

.1 System name.

.2 List of devices.

.3 Step-by-step procedures for testing each controller after installation, including:

.4 Process of verifying proper hardware and wiring installation.

.5 Process of downloading programs to local controllers and verifying that they are addressed correctly.

.6 Process of performing operational checks of each controlled component.

.7 Plan and process for calibrating valve and damper actuators and all sensors.

.8 Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.

.9 Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.

.10 Description of the instrumentation required for testing.

.11 Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.

2.3 FUNCTIONAL TEST PLANS (FTPS)

.1 The FTP procedures at the minimum shall consist of the following sections:

.1 Report Information:

.1 This section of the cover page provides general information on the functional test plan with respect to the project information including site and equipment location.

.2 Revision Information:

.1 This section of the cover page indicates to the reader if the functional test plan has been updated or revised

.3 Testing Approval:

.1 This section of the cover page provides a commissioning team sign-off to indicate the functional testing to the assigned equipment has been completed with all outstanding issues found addressed. / resolved.

.4 System Performance Approval:

.1 This section is intended to validate the equipment to be testing to ensure all components are accurate to the contract documents.

.5 Prefunctional Checklist:

.1 This section indicates the prefunctional check on the associated equipment to for the functional test plan. It will provide a confirmation of the readiness of the equipment for integrated systems testing by verifying that all required prefunctional checks have been completed and that the equipment can proceed into the testing phase.

.6 Point to Point verification

.1 A Complete punch list for all deficiencies for the controls vendor

.2 A complete “points” verification of all analog and digital points in the I/O summary

.3 A complete demonstration that all sequences of control are working as intended

.4 Review controls vendor’s graphics for compliance and agreement with the City’s existing control graphics

.7 Functional Performance Test Plan:

.1 This section shall provide information on the reference documents used to create the functional test plan.

.2 A Complete punch list for all deficiencies for the controls vendor

.3 A complete “points” verification of all analog and digital points in the I/O summary

.4 A complete demonstration that all sequences of control are working as intended

.5 Review controls vendor’s graphics for compliance and agreement with the City’s existing control graphics

.8 Occupancy Schedule :

.1 This section will outline the operational hours desired for this equipment as desired by the City.

.9 System Set Points:

.1 This section will outline the required operational set point and ranges for the equipment as outlined by the Contract Administrator.

.10 Balancing Review

.1 This section will confirm that the balancing report have been received, reviewed and that the actual measurements are meeting the design. This section will summarize that balancing of the equipment and system has been sufficiently completed.

.11 Sensor Calibration

.1 This section will review and check the sensors from the Operator Work Station and physically at the sensor location to confirm equipment tie in and operation on the Building Automation System and Building Operation user-ability.

.12 Device Calibration:

.1 This section will review and check the points from the Operator Work Station and physically at the device location to confirm equipment tie in and operation on the Building Automation System and Building Operation user-ability.

.13 Trend Log Verification

.1 This section shall verify the BAS points with trending capability.

.14 Functional Performance Sequence verification

.1 This section will provide:

.1 Sequential steps required to set parameters and conditions required to test component and functions throughout intended ranges of operation.

.2 Full range of checks and tests carried out to determine if electric and pneumatic connections, components, subsystems, systems and interfaces between systems function in accordance with the contract documents and design intents.

.3 All modes and sequences of control operations, interlocks and conditional control responses and specified responses to abnormal emergency conditions.

.15 Control Sequence and Drawings:

.1 This section provides a record and reference of all sequences and drawings used and tested for the functional test plan.

2.4 ISSUE LOG:

.1 This section records notes or remarks during system commissioning.

.2 List systems modifications, not required by the Contract Documents, but provided by the Subcontractor. List other questions regarding such system modifications.

.3 List problems discovered during Commissioning that were corrected.

.4 List problems discovered during Commissioning that were not corrected.

.5 List recommended party that should take action on these problems.

3 Execution

3.1 GENERAL

.1 The Subcontractors shall be responsible for performing procedures presented in specification and contract drawings as detailed in the Functional Performance Tests (FTP). Members of the designated Commissioning Team shall witness various portions of the commissioning process. Responsibilities for these activities are listed in the following paragraphs. Commissioning Team members shall sign-off on appropriate sections after verifying installation, operation, or documentation. Final sign-off shall be by the City and Commissioning Agent.

.2 Any test ports, gauges, test equipment, etc., needed to accomplish the functional performance tests shall be provided by Subcontractors.

.3 Subcontractors shall provide to the Commissioning Team documentation of calibration of controls. Documentation shall include dates, setpoints, calibration coefficients, control loop verification, and other data required to verify system check-out. Documentation shall be dated and initialed by field engineer or technician performing the work.

3.2 INSTRUMENTATION

.1 Instrumentation will be provided by the Subcontractor. Instruments used for measurements shall be accurate. Calibration histories for each instrument shall be available for examination. Calibration and maintenance of instruments shall be in accordance with the requirements of NEBB or AABC Standards.

.2 Application of instruments and accuracy of measurements shall be in accordance with NEBB or AABC Standards.

3.3 DOCUMENTATION

.1 The installing Subcontractor shall be responsible for collection of pertinent data during system start-up and functional performance testing. The Subcontractor shall submit to the Commissioning Agent documentation of tests performed prior to and after system start-up. Documentation shall also include start-up procedures as approved by Commissioning Team.

.2 Documentation is to be typewritten on 8-1/2 by 11 inches (200 by 280 mm) paper and inserted in a 2 inches (50 mm) to 3 inches (75 mm) thick three ring binder. Indicate the project name, number, volume number, and volume title on the end panel of each binder.

.3 Provide a title sheet for each volume and list the following:

.1 Volume Title and Section Name and Number requiring this submittal.

.2 Project name, project number, and address.

.3 Subcontractor name, address, and phone number.

.4 Name, title, signature, and date of person making the submittal.

.5 Name of the City, a blank line for signature, and the date of person accepting the submittal.

.6 Name, address, and phone number of Commission Agent; a blank line for signature; and date of person accepting the submittal.

.4 Provide a Table of Contents for multiple submittals. List each submittal and page number. Number each page, centered on the bottom in sequential numerical order. Provide tabs for multiple submittals in a single binder.

3.4 INSTALLATION VERIFICATION

.1 General Commissioning responsibilities:

.1 Before system start-up begins, the Commissioning Team should conduct a final installation verification audit. The Subcontractor shall be responsible for completion of work including change orders and punch list items to the City's satisfaction. The audit shall include, but not be limited to, checking of:

.1 Piping specialties including balance, control, and isolation valves.

.2 Ductwork specialty items including turning devices, balance, fire, smoke, control dampers, and access doors.

.3 Control sensor types and location.

.4 Identification of piping, valves, equipment, controls, etc.

.5 Major equipment, pumps, valves, starters, gauges, thermometers, etc.

.6 Documentation of prestart-up tests performed, including manufacturer's factory tests.

.2 If work is found to be incomplete, incorrect, or non-functional, the Subcontractor shall correct the deficiency before system start-up work proceeds.

3.5 SYSTEM START-UP

.1 General Commissioning Responsibilities:

.1 A start-up plan shall be developed and submitted by the installing Subcontractor. Start-up plan to include the following:

.1 Flushing and cleaning of pipe.

.2 Filters, strainers, and screens.

.3 Valve/damper positions.

.4 Electrical tests.

.5 Pressure tests.

.6 Safeties.

.7 Chemical treatment.

.8 Manufacturer's tests.

.2 The start-up plan will be reviewed and a prestart-up inspection performed by designated members of the Commissioning Team. The installing Subcontractor shall commence with system start-up after approval has been given to start-up plan and the prestart-up inspection is completed. Designated members of the Commissioning Team shall witness system start-up and list system and equipment deficiencies noted during start-up. The Subcontractor shall take corrective action on system deficiencies noted and demonstrate to the Commissioning Team members suitable system operation.

.3 Designated systems requiring test and balance work shall have this activity commence after systems have successfully completed start-up. System and equipment deficiencies observed during this activity is to be noted and corrected.

.4 Coordinate and supervise the start-up of the various pieces of equipment and systems. Utilize the start-up services of the manufacturer's representative. Ensure that the equipment is operating in a satisfactory manner. Check the following items:

.1 Direction of rotation.

.2 Grease and lubricants.

.3 Noise, if deemed to be a problem.

.4 Seals.

.5 Alignment of pump and fan drives by a millwright.

.6 Piping connections and safeties.

.7 Electrical amp draw, starting inrush current and trip / heater settings.

.8 Meet Section 23 00 00 - General Requirements criteria for Temporary Services, Trial Use, and Early Occupancy.

3.6 FUNCTIONAL TESTING

.1 General Commissioning Responsibilities:

.1 Functional Testing begins once the testing, adjusting, and balancing of the systems have been completed by the Subcontractors.

.2 The objective of the Functional Testing is to advance the building systems from a state of substantial completion to full dynamic operation in accordance with the specified design requirements and design intent.

.3 Attaining this object will be accomplished by developing individual systems testing protocols which, when implemented by the Subcontractor, will allow the Commissioning Team to observe, evaluate, identify deficiencies, recommend

modifications, tune, and document the systems and systems equipment performance over a range of load and functional levels.

.4 Functional Test Plans for the systems to be commissioned are defined in the Commissioning Plan. These tests are intended to be conclusive but may require minor modifications as system operation dictates.

.2 Corrective action:

.1 Take correct action as necessary to rectify items noted in the Issues Log at no additional charge to the City

3.7 MONTORING-BASED COMMISSIONING (MBCX)

.1 Refer to 01 91 00 General Commissioning Requirements.

3.8 OPERATIONS AND MAINTENANCE MANUALS

.1 Refer to 01 91 00 General Commissioning Requirements.

3.9 OPERATIONAL STAFF TRAINING

.1 System narrative descriptions will be prepared by the Commission Agent and supported by flow diagrams, one line diagrams, and appropriate specification sections for major systems to be commissioned. The Commission Agent will coordinate “system description” meetings with members of facility management and maintenance department groups to review system description documentation. The meetings will provide an overview of major system features, components, and arrangements.

.2 The Subcontractor and associated manufacturer’s representatives shall provide required training to operational staff after the system description meetings have occurred. The Subcontractor training sessions shall provide a more detailed analogy of systems operation and maintenance.

3.10 SYSTEMS MANUAL

.1 The Systems Manual is intended to be a usable information resource containing all of the information related to the systems, assemblies, and commissioning process in one place with indexes and cross references. The systems manual will be developed by the Cx with assistance from the Contract Administrator and the City’s representatives.

.2 The requirements for the Systems Manual are as follows:

.1 Refer to 01 91 00 General Commissioning Requirements.

3.11 LESSONS LEARNED

.1 A lessons learned review is held on site with the entire Commissioning Team in attendance after completion of all commissioning activities and before the end of the warranty period. The purpose of the review session is to obtain honest, objective, and constructive feedback on the effectiveness of the commissioning process used and changes that will improve the delivered project. The CxA documents the issues, benefits, and recommendations of this session for inclusion in the final commissioning report.

3.12 WARRANTY REVIEW

.1 During the warranty period, seasonal testing and other deferred testing required is completed according to the specifications. Tests are executed and deficiencies corrected by the appropriate subs, witnessed by the CxA. Any final adjustments to the O&M manuals and as-builts due to the testing are made. Approximately 10 months into the warranty period, a one day review session is held on site to review systems operation with O&M staff prior to expiration of the warranty.

3.13 SEASONAL / DEFERRED TESTING

.1 Unforeseen Deferred Tests: If any test cannot be completed due to the building structure, required occupancy condition, or other deficiency, the functional testing may be delayed upon approval of the City. These tests are conducted in the same manner as the seasonal tests as soon as possible.

.2 Seasonal Testing: Seasonal variation in operations or control strategies may require additional testing during the opposite season to verify performance of the HVAC system and controls. During the warranty period, seasonal testing and other deferred testing is completed as required to fully test all sequences of operation. Operation coordinates these activities. Tests are executed and documented, with deficiencies corrected by the appropriate contractors. Any final adjustments to the O&M manuals and as-builts due to the testing are also completed.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 91 00 – General Commissioning Requirements

.2 Section 22 08 00 – Commissioning of Plumbing

.3 Section 23 08 00 – Commissioning of HVAC

.4 Section 23 52 16 – Commissioning of Boiler and Interconnected pressure piping

.5 Section 25 08 00 – Commissioning of Integrated Automation

.6 Section 26 08 00 –Commissioning of Electrical

1.2 INTENT

.1 Provide and install a new Building Management/ Automation System (BAS) to control, monitor and report on the operation of all equipment and devices as specified in the Contract Drawings and Specification including but not limited to:

.1 One (1) complete operator workstation/s to use as the primary interface into the BAS.

.2 Operator portable laptop to use as the secondary interface into the BAS c/w connectivity to each BAS control panel.

.3 Where equipment is provided/ needed for redundancy, controllers are to maintain the level of redundancy of the equipment they serve. Controllers should be considered as a single point of failure, and one controller should not serve both the base, and redundant equipment.

.4 Building Automation Control systems to be provided with spare capacity to allow for future expansion. This includes main control points and boards, controllers, software, etc. both with respect to physical space allowances, and hardware allowances.

.5 Buildings automation system shall incorporate all points needed for building performance measurement and verification, metering and energy consumption.

.6 Custom built graphics for the project including an overview, floor plans, individual graphics for each system and summary graphics for system comfort and mechanical equipment operation.

.7 It is the intent of this Section that the Air Handling Unit supplier is provided with the specified control components required to be installed within or on the air handling units for installation by the AHU manufacturer at its factory. The AHU manufacturer is to install the specified control components on or within the unit, including conduit for all control wiring and copper or plenum rated polyethylene tubing for all differential pressure devices such as flow transmitters so that penetrations of the unit will not be required after the unit arrives at the Site.

.8 The Contractor is to provide all required installation documents, instructions and supervision required at the AHU manufacturer's factory to ensure that control components, including wiring, are installed according to this Section's requirements.

.9 The Contractor is to verify correct installation and operation of the controls at the AHU manufacturer's factory in conjunction with the manufacturer.

.10 All control components not installed on custom AHUs shall be field installed by the Contractor.

.11 The Contractor shall provide ALL VFD's, ALL motor starters, and ALL control wiring and interfaces to ALL mechanical equipment and devices and to all other external systems interfaced with the BAS.

.2 City of Winnipeg requirements:

.1 The Contractor shall provide and install all essential hardware and software to interface to the existing City of Winnipeg Extended Application and Data Server (ADX).

.2 The Contractor shall design the Metasys User Interface (MUI), to match the existing system. MUI graphics shall use the City of Winnipeg templates.

.3 The Contractor will not have access to the City of Winnipeg SCT server. All MUI files shall be provided by the BMS contractor in the correct format for merging into the existing system with support from the City of Winnipeg.

.4 The Contractor shall create or add MUI user views to match existing structure.

.5 There is an existing central monitoring system in place. All Direct Digital Controller (DDC) points are identified as centrally monitored points.

.6 All new controls shall be the Series Network Engine (SNE-XX000) supervisory controller which will utilize BACnet/IP and \ or MS/TP field controllers. The Contractor is required to meet with the City of Winnipeg for additional requests if the SNE-XX000 is not in the projects design or additional requirements are required. See note #2 and 3.

.7 Field Controllers shall communicate through BACnet/IP or MSTP bus to a SNE-XX000 supervisory controller. See note #1, and 2.

.8 No LON protocols are to be accepted.

.9 The Contractor to provide commissioning sheets for all points on field devices.

.10 The Contractor to communicate with equipment provider to ensure proper field point integration as well as controllability of the equipment, if not package controls.

.11 The system shall meet the City requirements for Building Automation, Security, Information Technology (IT), Accessibility, including Furniture, Fixtures and Equipment.

.12 If Other vendor (non-JCI) controls are to be used, then a seamless integration must be proven before approval will be given. Submit written declaration of acceptance and compliance for City review. Refer to notes #a to e.

.13 Notes:

.1 The term BACnet refers to an industry standard protocol which complies with ASHRAE and must be listed with the BACnet International / BACnet Testing Laboratories (BI/BTL). Basically, states that all devices using the BACnet technology will be able to communicate to each other. The controls contractor performing the controller installation should confirm that all devices specified are able to communicate to the proposed devices. Then supply documentation such that all devices supplied will communicate to each other as required for proper operation of the system (PICS Statement, BI/BTL Listing, and ASHRAE listings).

.2 If the Metasys Series Network Engine (SNE) are to be installed on the project then the version of these devices and their software must be such that the City of Winnipeg does not be required to update/upgrade the existing ADX server in order for all user views, alarms, and point monitoring to occur. The contractor must co-ordinate with City staff to determine the correct version to be installed.

.3 If the Metasys Series Network Engine (SNE) is existing, the contractor is required to meet with the City of Winnipeg for additional directions.

.4 All points must be integrated back to the City of Winnipeg ADX server. Important: The only way to bring points into the ADX server is to route them through a Johnson Controls supervisory device.

.3 Provide/ Incorporate LEED monitoring and reporting requirements in each mechanical system and at building level.

.4 The control system shall consist of a high speed, peer to peer network of direct digital controllers (DDC), a control system, a dedicated server to archive data and store system database, and a web-based operator interface. The system shall utilize distributed control and not rely on any single controller.

.5 The system software shall be designed around open standards. The control system server shall be accessed using a web browser over the control system network, the City's LAN or over the internet. No special software other than a web browser shall be required to access system information.

.6 The BAS shall use the BACnet protocol for communication to the operator workstation, the web server and for communicating between controllers. The system shall be designed around the ANSI/ASHRAE BACnet Standard 135. No gateways shall be used for communication between controllers provided and installed by this Section. Gateways may be used to communicate to systems provided by others, by written permission only.

.7 The system architecture shall be designed such that a single controller shall only control a single system. Failure of a single controller shall not result in a system wide failure. Minor systems such as exhaust fans and reheat coils shall be exempt from the single controller rule.

.8 The open system architecture shall allow the system to integrate to multiple vendors. Vendors are responsible for converting their system to the BACnet standard for integration into the BAS. Provide integration, assistance, interface and programing for systems provided by other Divisions into the new HVAC control system.

.9 The system shall be capable of future expansion through the addition of control devices, DDC controllers and/or operator devices. System shall have the capability of a 20% expansion on all tiers.

.10 The server shall provide the following functions, as a minimum:

.1 Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.

.2 Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any control unit in the network, local or remote.

.3 The server shall include a master clock service for its subsystems and provide time synchronization for all control units.

.4 The server shall provide scheduling for all control unit and their underlying field control devices.

.5 The server shall provide demand limiting that operates across all control unit.

.6 The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shedding lists for effective demand control.

.7 The server shall implement the BACnet Command Prioritization scheme for safe and effective contention resolution of all commands issued to control unit.

.8 Each control unit supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.

.9 The server shall provide central alarm management for all control unit supported by the server.

.10 Routing of alarms to display, printer, email and pagers

.11 View and acknowledge alarms

.12 Query alarm logs based on user-defined parameters

.13 The server shall provide central management of log data for all control units supported by the server.

.14 Log data shall include process logs, runtime and event counter logs, audit logs and error logs.

.15 Viewing and printing log data

.16 Exporting log data to other software applications

.17 Query log data based on user-defined parameters

.18 Maintain all trending data for minimum 36 months, and or as per LEED requirements.

1.3 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 20 05 93 – Testing, Adjusting, and Balancing (TAB).

.3 Section 20 00 80 – Variable Frequency Drives

.4 Section 22 11 19 – Domestic Water Piping Specialties.

.5 Section 22 11 23 – Domestic Water Pumps.

.6 Section 22 13 29 – Sump Pumps and Pits.

.7 Section 22 15 13 – Compressed Air Systems.

.8 Section 22 34 36 – Domestic Water Heaters and Tanks.

.9 Section 23 08 00 – Commissioning of HVAC

.10 Section 23 21 23 – Hydronic Pumps.

.11 Section 23 30 00 – HVAC Ducts and Plenums

.12 Section 23 33 00 – Air Ducts Accessories

.13 Section 23 34 00 – HVAC Fans.

.14 Section 23 36 00 – Variable Air Volume Terminal Units.

.15 Section 23 52 15 – Gas Fired Condensing Boilers.

.16 Section 23 52 16 – Condensing Boilers.

.17 Section 23 62 16 – Air To Water Heat Pump

.18 Section 23 65 10 – Forced Draft Cooling Towers

.19 Section 23 72 00 – Hydronic Air Handling Units.

.20 Section 23 74 00 – Gas-fired Air Handling Units.

.21 Section 23 82 16 – Air Duct Coils.

.22 Section 23 82 19 – Fan Coil Units.

.23 Section 23 82 36 – Finned-Tube Convectors and Enclosures.

.24 Section 23 82 39 – Cabinet and Unit heaters.

.25 Section 23 83 16.2 – Snow melt In Floor Heating Systems

.26 Section 23 84 13 – Humidifiers.

.27 Section 25 95 00 – Sequence of Operation, series.

1.4 REFERENCES

.1 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 135, BACnet-A Data Communication Protocol for Building Automation and Control Networks.

.2 International Society of Automation (ISA).

.3 Canadian Standards Associated (CSA).

.4 CSA C22.1 - Canadian Electrical Code.

.5 Underwriters Laboratories (UL).

.6 National Building Code (NBC).

.7 American National Standards Institute (ANSI):

.1 INCITS 4: Information Systems - Coded Character Sets - 7-Bit American National Standard Code for Information Interchange (7-Bit ASCII).

.8 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):

.1 Handbook Fundamentals.

.2 Guideline 3: Reducing Emission of Fully Halogenated Refrigerants in Refrigeration and Air-Conditioning Equipment and Systems.

.3 135: A Data Communication Protocol for Building Automation and Control Networks.

.9 American Water Works Association (AWWA):

.1 C704: Propeller-Type Meters for Waterworks Applications.

.10 Electronic Industries Alliance (EIA):

.1 TIA-232-F: Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

.2 485: Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multi-point Systems.

.11 Federal Communications Commission (FCC).

.12 International Organization for Standardization (ISO):

.1 8802-3: Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks.

.2 9001:2015, Quality management systems – Requirements.

.13 National Fire Protection Association (NFPA):

.1 90A: Standard for the Installation of Air Conditioning and Ventilating Systems.

.14 Underwriters Laboratories, Inc. (UL):

.1 916: Standard for Safety Energy Management Equipment.

1.5 DEFINITIONS

.1 The terms “HVAC Control System,” “Automatic Temperature Control System,” “Building Automation System,” and “Energy Monitoring Control System” shall be considered equivalent and used interchangeably for the purposes of this Contract.

.2 Algorithm: A software procedure for solving a recurrent mathematical or logical problem.

.3 Analog: A continuously varying signal or value (temperature, current, velocity, etc.).

.4 Binary: A two-state system where an “ON” condition is represented by a high signal level and an “OFF” condition is represented by a low signal level.

.5 Control Wiring:

.1 Wiring, high or low voltage other than power wiring required for proper operation of mechanical systems.

.2 Includes conduit, wire and wiring devices to install a complete control system including motor control circuits, interlocks, thermostats, and like devices.

.3 Includes wiring from DDC panels to all sensors and points defined in the Drawings, Device and Control Wiring Lists in Division 26, or specified herein and required to execute the sequence of operation.

.6 Power Wiring:

.1 Includes necessary power wiring (120V and/ or 24V inclusive of transformers) to HVAC control devices, and digital controllers including terminal units and actuators.

.7 Control Process: Software required to complete control loop from input signal to interlock logic and process calculation to final output signal control.

.8 Deadband: Temperature range over which no heating or cooling energy is supplied, such as 22 to 25 degrees C; as opposed to single point changeover or overlap, or a range from a set point over which no control action is taken.

.9 Direct Digital Control (DDC): Consists of microprocessor-based controllers with control logic performed by software. Analog-to-digital (A/D) converters transform analog values into digital signals that microprocessors can use.

.10 Power Wiring: Line voltage wiring to mechanical equipment. Line voltage wiring that also serves as control circuit, such as line voltage thermostat, or involves interlocking with damper shall be considered control wiring.

.11 Abbreviations that may be used in this Section:

.1 AI: Analog Input.

.2 AC: Air Conditioning.

.3 ANSI: American National Standards Institute.

.4 AO: Analog Output.

.5 ASC: Application Specific Controller.

.6 ASCII: American Standard Code for Information Interchange.

.7 ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers.

.8 ATC: Automatic Temperature Control.

.9 AWG: American Wire Gauge.

.10 AWS: Advanced Operator Workstation (BACnet Standard).

.11 BACnet: Building Automation Controls Network.

.12 BAS: Building Automation System.

.13 BIBB: BACnet Interoperability Building Block.

.14 BCC: Building Control Contractor.

.15 BCM: Building Control Module.

.16 CMOS: Complementary Metal Oxide Semiconductor.

.17 CPU: Central Processing Unit.

.18 DB: Dry Bulb (temperature).

.19 DDC: Direct Digital Control.

.20 DI: Digital Input.

.21 DO: Digital Output.

.22 DX: Direct Expansion.

.23 EP: Electro-Pneumatic.

.24 EEPROM: Electronic Erasable Programmable Read Only Memory.

.25 EIA: Electronic Industries Alliance.

.26 EMCS: Environmental Management and Control System.

.27 EEPROM: Electronically Erasable Programmable Read Only Memory.

.28 EMI: Electromagnetic Interference.

.29 EMT: Electrical Metallic Tubing.

.30 GUI: Graphical User Interface.

.31 IEEE: Institute of Electrical and Electronics Engineers.

.32 HCP: HVAC Control Panel.

.33 GLS/R: Hot Glycol Supply/Return.

.34 HMI: Human-Machine Interface.

.35 HOA: Hand-Off-Auto (Switch).

.36 HVAC: Heating, Ventilation, and Air Conditioning.

.37 I/O: Input/Output.

.38 ISP: Internet Service Provider.

.39 IP: Current (I) - Pressure (P), as in IP transducer.

.40 LAN: Local Area Network.

.41 LCD: Liquid Crystal Display.

.42 LED: Light Emitting Diode.

.43 MSCR: Manual Speed Control Regulators.

.44 MCC: Motor Control Center.

.45 NP: Non-potable Water.

.46 OWS: Operator Workstation.

.47 PC: Personal Computer.

.48 PIC: Protocol Implementation Conformance Statement.

.49 PLC: Programmable Logic Controller.

.50 POI: Portable Operator’s Interface.

.51 POT: Portable Operator’s Terminal.

.52 PICS: Protocol Implementation Conformance Statement.

.53 PICV: Pressure Independent Control Valve.

.54 RAM: Random Access Memory.

.55 RF: Radio Frequency.

.56 RFI: Radio Frequency Interference.

.57 RH: Relative Humidity.

.58 RTD: Resistance Temperature Detectors.

.59 TCP/IP: Transmission Control Protocol/Internet.

.60 TRGSC: Threaded Rigid Galvanized Steel Conduit.

.61 VLC: Visual Logic Field Controller.

.62 WB: Wet Bulb (Temperature).

.63 UPS: Uninterruptible Power Supply.

.64 VLAN: Virtual Local Area Network.

.65 VFD: Variable Frequency Drive.

.66 WAN Wide Area Network.

1.6 SUBMITTALS

.1 Submit shop drawings in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

.2 Shop drawings shall be submitted electronically and/or hard copies, as per Contract agreement, on 11 x 17 paper.

.3 Quantity of items submitted shall be reviewed but are the responsibility of the Controls Contractor.

.4 Shop drawings to include:

.1 Title Page + Table of Contents

.2 Network Architecture:

.1 Network layout showing all networks associated with the Project.

.2 HVAC Control Systems network architecture drawings including all nodes, interconnections, and controller locations/identifiers.

.3 Connection to City's LAN and/or internet.

.4 Details of all panels, controllers and routers provided for the Project including their location, type and power feed. DDC controller panel layout diagrams showing all components contained within and/or on panels.

.5 PIC/BIBB statement clarifying which BACnet objects and services are supported by each applicable controller.

.6 Operator interface devices (workstations, laptops etc.).

.3 Schematic Drawings:

.1 Provide detailed drawings showing equipment or system layout and complete points list.

.2 Show all control devices and their location.

.3 Provide bill of material for all devices.

.4 Show controller point names and address for all devices.

.4 Sequence of Operation:

.1 Use wording indicated on design drawings for sequences of operation. Changes to design sequences shall not be made without first discussing and getting approval from the Engineer.

.2 Provide detail description for the operation of each system.

.3 Indicate all modes of operation, safety interlocks, control strategies, alarms and operating procedures.

.5 Schedules:

.1 Provide for all systems, control valves, control damper actuators, airflow stations, meters, terminal units and equipment as required.

.2 Control Damper Schedule including a separate line for each damper provided under this Section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting installation details and structural reinforcement and/or supports to meet system operational pressures and air flow velocities and /or wind loads for all building envelope installed dampers, and Actuator Type. Include damper actuator sizing calculations, in schedule form

.3 Control Valve Schedules including a separate line for each valve provided under this Section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body, Configuration, Close-off Pressure, Capacity, Valve pressure drop, Design Pressure, and Actuator Type. Include control valve sizing calculations, in schedule form.

.6 Wiring Diagrams:

.1 Diagrams to show exact termination details for controllers and control devices.

.2 Control and power wiring diagrams for all connected systems, devices, indicating, equipment/ system interlocks, DDC control/monitoring points, control wiring interconnections to VFDs, equipment and devices, voltage requirements and all other network communication and other connections. In addition to any point/device nomenclature used by this Section indicate the City's required nomenclature as indicated on the Contract Drawings.

.7 Data Sheets.

.1 Technical specification data sheets for each and every system component and software module. Clearly indicate the specific device part number/code being used where multiple selections and/or options are indicated. Include photo and description for all Products. For hardware devices include make, model, dimensions, weight of equipment, and electrical schematics, for all control system components.

.8 List/ trends.

.1 Detailed lists of all trending (all control points shall be trended), alarms, alarm priority, setpoints and scheduling.

.9 BAS control screens.

.1 Graphical details of all the BAS systems screens, diagrams, alarms, trend, etc.

.2 Incorporate comments provided to the graphics by Contract Administrator and the City.

.5 Operation and Maintenance Manuals

.1 An Operation and Maintenance manual shall be provided in both hard copy and compact disc media and shall include:

.1 Table of Contents

.2 The manufacturer's technical literature/specification for every system and component comprising the HVAC Control Systems.

.3 Calibration and maintenance instructions for all equipment.

.4 As-built (record) versions of shop drawings for all controlled systems. Revised shop drawings to reflect required changes discussed and agreed upon during the commissioning process.

.5 Layout drawings showing the installed location of all hardware devices.

.6 Interfaces to all third-party Products and work by Other Contractors.

.7 Descriptions and instructions on the use of all installed hardware, software (including the Graphical User Interface) and firmware. The level of detail shall be enough to permit the City to create their own colour graphics, including set-up of real time points, from scratch.

.8 Archive copy of all Site-specific databases, control programs (sequences) and setpoints.

.9 Licenses guarantee and warranty documents for all equipment and systems.

.10 As-built diagrams of all control panels, VFD external control interfaces and starter controls including hardware layouts and wiring diagrams, where applicable.

.2 The Operation and Maintenance Manual CD/DVD shall be self-contained, and include all necessary software required to access the Product data sheets. A logically organized table of contents shall provide dynamic links to view and print all Product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

.3 Maintenance manuals shall include instructions covering the operation, maintenance and troubleshooting of all controlled systems.

.4 Supply three (3) copies of HVAC Control Systems Manuals for the project.

.5 All manuals shall be finalized and available at the Site for use during operation and maintenance training.

.6 Provide copies of final installed software programs on CD/DVD ROM.

.6 Information Submittals:

.1 Start-Up & Commissioning Data.

.2 A draft maintenance agreement.

.3 Confirmation that the control system supplier has received and coordinated with all approved HVAC equipment submittals.

.4 Experience and qualifications of the control system supplier’s proposed representative who will supervise installation, adjustment, and calibration of control systems.

.5 Performance test plan and schedule.

.6 Test Results:

.1 Functional and performance test documentation.

.2 Component calibration sheets for each instrument and panel component.

.7 Operation and maintenance data, including but not limited to the following detailed information:

.1 Operation and maintenance instructions for control system as furnished and installed, including control of associated mechanical and electrical equipment.

.2 Record of system adjustments and calibration methods.

.3 Performance test results.

.8 Start-Up and Commissioning Data: Submit start-up and commissioning data in accordance with requirements specified in other Contract sections.

.9 Control Work Certification: When control work has been completed and has been tested and adjusted at the site, certify in writing that the controls are complete, operational, and ready for acceptance.

1.7 GENERAL SYSTEM REQUIREMENTS

.1 Provide a HVAC Control System consisting of a networked, fully distributed processing, on-line, real-time, direct digital control system consisting of microprocessor-based, direct digital controllers for control and monitoring of air handling, heating and ventilation, cooling and other specified systems. The HVAC Control System is to consist of the following:

.1 Operator Workstations and Portable Operator Interface (POI).

.2 Field sensors and control components.

.3 Operating, application and system specific software.

.2 The HVAC Control System network is to utilize an open architecture capable of each and all the following:

.1 Communication at the BCM level (Tier 1) via a high-speed Ethernet TCP/IP network configuration according to ANSI / ASHRAE™ Standard 135.

.2 Provide Modbus/TCP communication gateways to enable Third Party system to read HVAC control points.

.3 The controls systems are to include the necessary hardware, equipment and software to allow all controls systems application facilities and features to be accessible via the City's WAN and an Internet Browser.

.4 The software tools required to network manage the ANSI / ASHRAE™ Standard 135 BACnet protocol must be provided with the system.

.5 All applicable devices shall have a Protocol Implementation Conformance Statement (PICS) that identifies all the portions of BACnet that are implemented.

.6 The controls systems application software tool provided for the generation of custom and database definitions are to be resident in the BACnet Advanced Operator Workstation (AWS).

.7 The system is to be modular in nature and is to permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices.

.8 Each DDC Controller is to operate independently by performing its own specified control, alarm management, operator I/O and data collection.

.9 All DDC Controllers are to be complete with all required hardware and software to permit connection together to form a network. This means that DDC controllers are to be able to access any data from, or send control commands and alarm reports directly to, any other DDC Controller or combination of controllers on the network without dependence upon a central processing device. DDC Controllers are to also be able to send alarm reports to multiple operator workstations without dependence upon a central processing device.

.10 VLCs are to have the capability to interface directly with a graphic display interface without the need for additional communication cards and software.

.11 Major control components, material and equipment are to be the catalogue products of a single manufacturer regularly engaged in production and installation of automatic temperature control systems and accessories. All Products are to be manufacturer's latest standard design that complies with the specification requirements.

.12 Install system using competent workmen who are fully trained in the installation of automatic HVAC Control Systems. Single source responsibility of the Contractor's supplier is to be for the complete installation and proper operation of the DDC control system and is to include debugging and proper calibration of each component in the entire system.

.13 The OWS Graphical User Interfaces shall provide PC-based, user-friendly interfaces that afford an Operator the means to access and display information about any of the systems controlled and monitored by the HVAC Control Systems. Provide English language operator interfaces using readily understood abbreviations and descriptors to provide a convenient means by which an Operator can access information and modify setpoints, schedules and control points comprising the HVAC Control Systems.

.14 The Contractor shall provide full technical assistance during testing, start-up, and commissioning of the overall system.

.15 Provide and install a server class computer to suit BAS system requirements.

.1 Minimum configuration:

.1 Sever 2U

.1 5 x Gigabit outlets

.2 Storage 1U

.1 2 x Gigabit outlets

.2 Server shall be fed from UPS power supply system.

1.8 WORK INCLUDED

.1 Provide all labour, material, tool, equipment and services, testing, commissioning, training sessions required to deliver a complete and functional BAS as shown on the Contract Drawings, City requirements and described in this Section and Section 25 95 00 – Sequence of Operation series.

.2 Supply, mounting as required, and connection of all required piping, duct and equipment/ room mounted control components.

.3 Provision of all computer hardware and software, operator interface devices, the local area network (LAN), fiber optic network, field sensors, transmitters and other control components required to meet the specified performance criteria.

.4 All required calibration, testing, commissioning, software programming and data base generation.

.5 Provision of all instruments, panels, push buttons, accessories, communication protocol gateways and other system interfaces.

.6 Coordination with Subcontractors and Other Contractors performing Work associated with the DDC controls, and coordination and cooperation with personnel performing mechanical, electrical, and other control system commissioning.

.7 Provision of 120 V power wiring between lighting panel circuits or other power circuits provided under Division 26 and field-mounted DDC panels and other control components requiring 120 V power. All required 120v/24v transformers. Power to AHU-mounted controls shall be through a 120 V power source termination provided at the unit by the AHU supplier.

.8 Control sequences and functions including trending, scheduling, alarms, monitoring and resetting functions, shall not be limited to point schedules and sequences of operation.

.9 Provide sequences and functions as required to deliver a fully functioning HVAC system.

.10 Provide an intuitive graphical user interface that allows the operators to easily monitor and control all systems. Provide floor plans, navigational graphics and graphics for all systems under control.

.11 Provide all DDC controllers, control devices, sensors, wiring, programming and commissioning for a fully operational system as described in this Section and Section 25 95 00 – Sequence of Operations series.

.12 Installation Management:

.1 All aspects of the project shall be performed under the direct supervision of the Controls Contractor. This includes design, wiring design, panel and field wiring, programming, testing commissioning and verification.

.2 Provide coordination services with other subcontractors as required.

.13 Controllers and Software:

.1 Provide a BACnet based DDC control and monitoring system that utilizes distributed control for the system as shown on the Contract Drawings and described in this Section.

.2 System shall be web based and built around the ANSI/ASHRAE Standard 135 (BACnet).

.3 Provide all programming to deliver the system and sequences as described in this Section.

.4 All software provided for the project including software to program the operator interface and field level controllers shall be licensed to the City. Provide a copy of all software used on the project to the City.

.5 All graphics and programs for the project shall be the property of the City. Provide backup copies of all programs and graphics.

.6 Provide all required Building Controllers.

.7 Provide all required Field Controllers.

.14 Control Devices:

.1 Provide all control dampers and actuators for all control dampers as shown on the Contract Drawings and/or as described in Section 25 95 00 – Sequence of Operations series.

.2 Provide all control valves and actuators as shown on the Contract Drawings and/or as described in Section 25 95 00 – Sequence of Operations series.

.3 Provide all control devices as shown on the Contract Drawings and/or described in Section 25 95 00 – Sequence of Operations series.

.15 Wiring:

.1 Supply and install all electrical 120v and 24v wiring for components. All wiring shall be in accordance with the governing electrical authority. This includes network wiring, wiring between control components and wiring from such components to electrical circuits of fans, pumps and any other piece of equipment.

.2 Electrical interlock wiring of field devices (i.e., flow switches, thermostats) associated with equipment specified under other sections of this Division is the responsibility of the contractor installing that equipment, unless indicated otherwise in this Section.

.3 Power at 120V/60Hz/1Ph shall be provided under Division 26 in each mechanical room, other rooms /ceiling for air terminals and each HVAC control panel and/or terminal units or package equipment and area as required by the control systems. This includes wiring and conduit up to control panels and electrical power from power panels to BAS panels. Controls Contractor to coordinate exact requirements and locations with Division 26.

.16 Hardware and Software Verification:

.1 Provide all work and documentation to confirm that all devices are installed, wired, programmed and operating as intended.

.2 Provide all work and documentation to confirm that all systems are operating as described in the sequence of operation on the Contract Documents.

.17 Operator Interface Devices:

.1 Provide operator workstations and laptop, as described in the Part 2 – Products of this Section.

.2 The operator workstations shall be located as per contract documents. Controls contractor shall confirm final location with the City.

.3 Include all hardware and software required.

.18 Documentation:

.1 Provide shop drawings and all documents necessary to supply and install the BAS.

.2 Provide all verification reports as necessary to confirm the installed BAS is fully functional and meets the Contract requirements.

.3 Provide all as built shop drawings, training manuals and operating manuals as required for the operator to manage and operate the facility.

.19 Commissioning and Training:

.1 Provide assistance as detailed in Part 3, “Testing and Balancing” of this Section and as required by the TAB Contractor and Commissioning Contractor to perform all aspects related to testing, adjusting, balancing and commissioning as detailed in Section 20 05 93 – Testing, Adjusting, and Balancing (TAB) and Section 01 91 00 – Commissioning Requirements.

.2 Provide training as detailed in Part 3, “Training” – Execution of this Section.

1.9 RELATED WORK

.1 Products furnished but not installed by this Section:

.1 Control valves;

.2 Immersion wells;

.3 Air flow stations;

.4 Liquid and Gas flow meters (for HVAC and plumbing flow control and energy monitoring).

.5 VAV terminal controllers.

.2 Products installed but not furnished by this Section:

.1 None.

.3 Products or services not furnished or installed by this Section:

.1 Electrical meters

.2 Access doors;

.3 Power wiring to control panels;

.4 Circuit breakers or power sources for controls; and,

.5 Internet connection.

.4 BACnet devices provided by others, but not limited to, for integration into the BAS:

.1 Chillers.

.2 Boilers.

.3 Packaged equipment.

.4 Air conditioning units and Computer room air conditioning units.

.5 Lighting.

.5 Misc. devices provided by others, but not limited to, for integration into the BAS:

.1 Electrical meters.

.2 Revenue Natural gas meters.

.3 Revenue Domestic water meters.

.4 Generators.

.5 Cogeneration units.

.6 Sump pumps.

.7 Heat tracing

.8 Water softening system.

.9 Domestic water heaters.

.10 Fuel oil system.

.11 HVAC fans.

.12 Humidifiers.

1.10 QUALITY ASSURANCE

.1 Comply with the quality requirements of Section 01 40 00 – Quality Requirements.

.2 All persons involved with the design, installation, programming and verification of the BAS shall be authorized and trained by the BAS Manufacturer.

.3 All materials and devices used on this project shall be new, regularly manufactured and shall be of the latest design standard.

.4 The installer shall have an established working relationship with the controls Supplier.

.5 The Controls Contractor shall provide an experienced project manager to oversee all aspects of the project including design, installation and start-up.

.6 Systems shall be the product of one manufacturer.

.7 Systems shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

.8 Materials, devices, appliances, and equipment used shall be indicated as acceptable by established standards of Underwriters Laboratories, Inc. (UL), Underwriters Laboratories of Canada (ULC) and Canadian Standards Association (CSA).

.9 Codes and Standards: Meet the requirements of the applicable standards and codes listed below, except when more detailed or stringent requirements are indicated by the Contract Documents, including the requirements of this Section.

.1 Underwriters Laboratories: Products shall be UL 916-PAZX listed or equivalent ULC and CSA listed.

.2 National Electrical Code NFPA 70.

.3 Federal Communications Commission Part J.

.4 Applicable portions of networked DDC Control Systems shall comply with latest version of ASHRAE 135 (BACnet).

.10 Qualifications of HVAC Controls System Supplier:

.1 Minimum of 15 years' experience in design, installation, and maintenance of fully electronic building automation systems.

.2 Minimum of 10 years' experience in design, installation, and maintenance of computer based, direct digital control, facility automation systems.

.3 Capable of furnishing factory-trained technicians, competent to provide instruction, routine maintenance, and emergency service on Site within 4 hours after receipt of request.

.4 Factory trained certified engineering and commissioning staff, and complete off Site training facilities.

.5 Necessary facilities to provide the City with complete maintenance, periodic inspection, and service contract. Refer to Maintenance subsection.

.11 FCC Regulation: Electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Section 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

.12 Compatibility:

.1 System shall have documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years.

.2 Compatibility shall be defined as:

.1 Ability to upgrade existing field panels to current level of technology and extend new field panels on previously installed network.

.1 Ability for any existing field panel microprocessor to be connected and directly communicate with new field panels without bridges, routers, or protocol converters.

.13 Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

.1 Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

.2 Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

.1 15 person-days.

.3 Functional Completion Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

.1 30 person-days.

.4 Field Performance Testing: Field performance test equipment specified.

.1 30 person-days.

.5 Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

.1 10 person-days.

.6 Credit to the City, all unused service person-days specified above, at the manufacturer's published field service rate.

.7 Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the City.

.14 Manufacturer of systems shall have a minimum of five (5) operating installations with systems of the size specified and in the same service as specified operating for not less than five (5) years.

1.11 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 40 00 – Quality Requirements, and Section 01 61 00 – Common Product Requirements.

.2 Corrosion Protection:

.1 Control panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, shall be protected from corrosion through use of corrosion-inhibiting vapor capsules.

.2 Prior to shipment, capsules shall be provided within shipping containers and equipment as recommended by the capsule manufacturer.

.3 During construction period, capsules shall be replaced in accordance with the capsule manufacturer's recommendations.

.4 All control panels shall be sufficiently protected by packaging prior to installation in order to prevent abrasion and denting of panels.

1.12 MAINTENANCE

.1 Maintenance Service Agreement.

.2 Furnish a draft maintenance and service agreement, prepared and signed by the Controls supplier, to provide the necessary preventive maintenance to keep the various control systems in proper working condition.

.3 Fully describe the maintenance Work to be performed and estimate the cost of the maintenance during the 24-month warranty period after Substantial Performance of the Work and the subsequent year.

.4 This service contract shall include 24-hour emergency service, 7 Days per week.

1.13 SYSTEM PERFORMANCE

.1 The installed system shall conform to the minimum performance standards as described on the Contract Documents.

.2 A graphic with 20 dynamic points shall display current data within 10 seconds.

.3 A graphic with 20 dynamic points shall refresh every 15 seconds.

.4 Screens for tuning shall refresh every 6 seconds.

.5 Commands from operator interface to device shall take no longer than 5 seconds.

.6 Alarms shall be annunciated at the workstation within 45 seconds.

.7 Field level controllers shall execute PID loops at a response time suitable for the application with the capability of executing once per second.

.8 Loop stability, but not limited to, and in accordance with the system control intent and operating range:

.1 Space temperature shall be maintained within +/- 1 Deg C of set-point.

.2 Return air humidity shall be maintained within +/- 5 %RH of set-point.

.3 Duct pressure shall be maintained within +/- 50 Pa of set-point.

.4 Fluid differential pressure shall be maintained within +/- 250 Pa of set-point.

.5 Air volume to be maintained within +/- 10% of set-point.

1.14 FINAL DOCUMENTATION

.1 Final documents shall be submitted within 4 weeks of acceptance.

.2 Provide electronic/ digital copy of all documentation on SD card. All electronic documents shall be in PDF format. Refer to Commissioning Plan and O&M manuals for delivery and quantity of copy format to required stakeholders.

.3 Documentation to include:

.1 Revised as built shop drawings indicating exact installation details;

.2 Verification documents;

.3 O&M manuals;

.4 Copies of all programs, graphics and database;

.5 Copies of software specific to the Project and all licenses;

.6 List of recommended spare parts; and,

.7 Recommended preventative maintenance and operating procedures.

1.15 OWNERSHIP OF PROPRIETARY MATERIAL

.1 All project specific software and documentation shall become the City's property. This includes but is not limited to:

.1 Record drawings;

.2 Graphics;

.3 Programs;

.4 Licensed software and,

.5 Database.

1.16 WARRANTY

.1 Warranty shall cover all costs for parts, labour, associated travel and expenses for a period of two (2) years following substantial completion of the Project.

.2 Control system failures during the warranty period shall be adjusted, replaced or repaired at no additional cost to the City.

.3 Controls vendor shall respond to failures within 24 hours of a call for service during normal business hours.

1.17 ACCEPTABLE MANUFACTURERS

.1 The following Building Automation Systems are approved installations:

.1 Johnson Controls.

.2 HTS Alerton.

.3 Automated Logic.

.4 Reliable Controls.

.5 Siemens.

.6 Honeywell.

.7 Note: refer to clause 1.4 -B.

2 Products

2.1 MATERIAL

.1 Use new products the manufacturer is currently manufacturing and selling for use in new installations.

.2 Do not use this installation as a product test site unless explicitly approved in writing by the Contract Administrator in writing.

.3 Spare parts shall be available for at least five years after completion of this contract.

.4 Control Components:

.1 Control the range to obtain the specified capacities.

.2 Sensitivity to maintain control points close enough to set point for acceptable offset, without cycling equipment more frequently than recommended by the manufacturer.

.3 Field or computer adjustable to actual set point ranges. Adjustable to other settings that will provide proper operation of entire control system.

.5 Controls Interfacing:

.1 Interface controls properly with factory supplied components of mechanical systems. Coordinate special control interfacing requirements.

.2 For equipment that requires special interfacing with control system, provide equipment with integral controls or provide accessory devices required for operation of total mechanical system.

.3 Coordinate interfaces with electrical Work as necessary.

.4 Provide electric, electronic, and mechanical devices as required to properly interface with prewired control panels furnished with HVAC equipment and with other mechanical and electrical components.

2.2 LABELING

.1 All Products, namely electrical materials, devices, appliances, and equipment used, shall be indicated as acceptable by established standards of Underwriters Laboratories, Inc. (UL), Underwriters Laboratories of Canada (ULC), Factory Mutual (FM) and Canadian Standards Association (CSA).

.2 A valid label affixed to an item shall provide indication of Product acceptance by the required agencies.

.3 HVAC control panels and control components that consist of multiple components shall bear UL, ETL, ULC and CSA listing mark on unit.

2.3 SERVICE CONDITIONS

.1 Refer to Division 26, and the Electrical Drawings for classification of areas as hazardous, corrosive, wet, indoor dry, and dust-tight.

.2 Use materials and methods and enclose devices in NEMA enclosure types suitable for the classification indicated, and as required by NFPA 70.

.3 Exhaust ductwork shall be considered the same classification as the area served.

.4 Instruments within 900 mm of ducts conveying air from spaces classified as Class I, Division 1 or 2 (in accordance with NFPA 70) shall be suitable for the same area classification as the space exhausted.

2.4 ELECTRICAL COMPONENTS AND ACCESSORIES

.1 Electrical components shall be provided in accordance with the requirements of Division 26 - Electrical.

.2 Wiring:

.1 In accordance with Division 26, NFPA 70 and Electrical Code

.2 Insulation shall be rated 600 volts, minimum.

.3 Electrical Raceways: In accordance with Division 26 and NFPA 70 and Electrical Code

2.5 ACCESSORIES

.1 Corrosion-inhibiting vapor capsules as manufactured by:

.1 Northern Technologies International Corporation; Model Zerust VC.

.2 Hoffman Enclosures Inc.; Model A-HCI

.3 Or approved equivalent

.2 Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 45 kg.

.3 Equipment Identification Plates:

.1 Provide a 16-gauge type stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. The plate shall bear 6 mm high engraved block type black enamel filled equipment identification number tags indicated on the Drawings. Provide Identification list for City approval prior to purchase or fabrication.

.2 Provide on or adjacent to all control devices, and for equipment whose function is not readily apparent, including:

.1 Manual Speed Control Regulators and VFDs

.2 Fan Control Stations and Starters

.3 Special purpose devices.

.4 HVAC control panels.

2.6 EQUIPMENT FINISH

.1 Provide materials and equipment with the manufacturer's standard finish system. Provide manufacturer's standard finish colour, except where a specific colour is indicated in the Contract Documents.

.2 If manufacturer has no standard colour, provide gray semi-gloss finish as approved by the Contract Administrator.

2.7 COMMUNICATION

.1 Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.

.2 Install new wiring and network devices as required to provide a complete and workable control network.

.3 Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

.4 Internetwork operator interface and value passing shall be transparent to internetwork architecture.

.5 An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.

.6 Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in the Contract Drawings and/or Contract Documents. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

.7 Workstations, Building Control Panels, and Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.

.8 System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

2.8 OPERATOR INTERFACE SOFTWARE

.1 General:

.1 The structure of the operator interface shall be a standard City's server relationship. Server shall be used to archive data and store system database. Clients shall access server for all archived data. Each client shall include flexibility to access graphics from server or local drive. Server shall support a minimum of 50 simultaneous clients.

.2 Graphical Display:

.1 Operator's workstation shall display all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display all data using three-dimensional graphic representations of all mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units, in International System of Units (SI). All information on any display shall be dynamically updated without any action by the user. Workstation shall allow user to change all field-resident BAS functions associated with the project, such as set-points, weekly schedules, exception schedules, etc., from any screen, no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.

.2 All displays and programming shall be generated and customized by the local BAS supplier and installer. Systems requiring factory development of graphics or programming of DDC logic shall be specifically prohibited.

.3 Binary objects shall be displayed as ACTIVE/INACTIVE/NULL or with customized text such as Hand-Off-Auto. Text shall be justified left, right or center as selected by the user. Also, binary objects shall be displayed as individual change-of-state graphic objects on the display screen such that they overlay the system graphic. Each binary object displayed in this manner shall be assigned up to three graphic files for display when the point is ON, OFF or in alarm. For binary outputs, toggle the object's commanded status when the graphic item is selected with the system mouse. Similarly, allow the workstation operator to toggle the binary object's status by selecting with the mouse, for example, a graphic of a switch or light, which then displays a different graphic such as an "ON" switch or lighted lamp. Additionally, binary objects shall be displayed as an animated graphic. Animated graphic objects shall be displayed as a sequence of multiple graphics to simulate motion. For example, when a pump is in the OFF condition, display a stationary graphic of the pump. When the operator selects the pump graphic with the mouse, the represented object's status is toggled and the graphic of the pump's impeller rotates in a time-based animation. The operator shall be able to click an animated graphical object or switch it from the OFF position to ON, or ON to OFF. Allow operator to change graphic file assignment and create new and original graphics online. System shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. Systems that do not allow customization or creation of new graphic objects by the operator (or with third-party software) shall not be allowed.

.4 Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic. Each analog input object shall be assigned a minimum of five graphic files, each with high/low limits for automatic selection and display of these graphics. As an example, a graphic representation of a thermometer would rise and fall in response to either the room temperature or its deviation from the controlling set-point. Analog output objects, when selected with the mouse, shall be displayed as a prompted dialog (text only) box. Selection for display type shall be individual for each object. Analog object values may be changed by selecting either the “increase” or “decrease” arrow in the analog object spinner box without using the keypad. Pressing the button on the right side of the analog object spinner box allows direct entry of an analog value and accesses various menus where the analog value may be used, such as trend logs.

.5 Analog objects may also be assigned to a system graphic, where the color of the defined object changes based on the analog object’s value. For example, graphical thermostat device served by a single control zone would change color with respect to the temperature of the zone or its deviation from set-point. All editing and area assignment shall be created or modified online using simple icon tools.

.6 A customized menu label (push-button) shall be used for display selection. Menu items on a display shall allow penetration to lower level displays or additional menus. Dynamic point information and menu label pushbuttons may be mixed on the same display to allow sub-displays to exist for each item. Each display may be protected from viewing unless operator has appropriate security level. A security level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.

.7 The BAS displays shall have the ability to link to content outside of the BAS system. Such content shall include but is not limited to: Launching external files in their native applications (for example, a Microsoft Word document) and launching a Web browser resolving to a specified Web address.

.8 The BAS system shall have the ability to run multiple, concurrent displays windows showing continuously updated data.

.9 The operator interface shall have the capability of allowing for zooming on maps that indicate the geospatial location of equipment. Enough resolution must be maintained at all levels.

.3 Password Protection:

.1 Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator’s assigned functions when user is logged on. This includes displays as outlined above.

.2 Each operator’s terminal shall provide security for a minimum of 200 users. Each user shall have an individual User ID, Username, and Password. Entries shall be alphanumeric characters only and shall be case sensitive (except for User ID). User ID shall be 1–8 characters, Username shall be 1–29 characters, and Password shall be 4–8 characters long. Each system user shall be allowed individual assignment of only those control functions, menu items, and user specific system start display, as well as restricted access to discrete BACnet devices to which that user requires access. All passwords, Usernames, and access assignments shall be adjustable online at the operator’s terminal. Users should have the capability to be assigned to specific user type “groups” that can share the same access levels to speed setup. Users who are members of multiple “groups” shall have the ability to activate/deactivate membership to those groups while using the BAS (without logout). Users shall also have a set security level, which defines access to displays and individual objects the user may control. System shall include 10 separate and distinct security levels for assignment to users.

.3 System shall include an Auto Logout Feature that shall automatically logout user when there has been no keyboard or mouse activity for a set period. Time period shall be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal shall display message on screen that user is logged out after Auto Logout occurs.

.4 The system shall permit the assignment of an effective date range, as well as an effective time of day, that the User IDs are permitted to authenticate.

.4 Operator Activity Log:

.1 Operator Activity Log that tracks all operator changes and activities shall be included with system. System shall track what is changed in the system, who performed this change, date and time of system activity, and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and by operation. Operator shall be able to print the Operator Activity log display.

.2 Log shall be gathered and archived to hard drive on operator's workstation as needed. Operator shall be able to export data for display and sorting in a spreadsheet.

.3 Any displayed data that is changeable by the operator may be selected using the right mouse button and the operator activity log shall then be selectable on the screen. Selection of the operator activity log using this method shall show all operator changes of just that displayed data.

.5 Scheduling:

.1 Operator's workstation shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.

.2 Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.

.3 Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.

.4 System shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting Schedule.

.5 Scheduling shall include optimum start based on outside air temperature, current heating/cooling set-points, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied set-point is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to set-point. User shall be able to set a limit for the maximum startup time allowed.

.6 Any displayed data that is changeable by the operator may be selected using the right mouse button and the schedule shall then be selectable on the screen. Selection of the schedule using this method shall allow the viewing of the assigned schedule or launch the Schedule Wizard to allow the point to be scheduled.

.6 Alarm Indication and Handling:

.1 Operator's workstation shall provide audible, visual, printed, and email means of alarm indication. The alarm dialog box shall always become the top dialog box regardless of the application(s) currently running. Printout of alarms shall be sent to the assigned terminal and port. Alarm notification can be filtered based on the User ID's authorization level.

.2 System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment, and identification of operator acknowledging alarm.

.3 Alarm messages shall be in user-definable text (English or other specified language) and shall be delivered either to the operator's terminal, client or through remote communication using email (Authenticated SMTP supported).

.4 System shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through all steps necessary for alarm generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting alarm setup.

.5 Any displayed data that is changeable by the operator may be selected using the right mouse button and the alarm shall then be selectable on the screen. Selection of the alarm using this method shall allow the viewing of the alarm history or launch the Alarm Wizard to allow the creation of a new alarm.

.7 Trend Log Information:

.1 System server shall periodically gather historically recorded data stored in the building controllers and store the information in the system database. Stored records shall be appended with new sample data, allowing records to be accumulated. Systems that write over stored records shall not be allowed unless limited file size is specified. System database shall be capable of storing up to 50 million records before needing to archive data. Samples may be viewed at the operator's workstation. Operator shall be able to view all trended records, both stored and archived. All trend log records shall be displayed in standard engineering units (SI).

.2 Software that can graph the trend logged object data shall be included. Software shall be capable of creating two-axis (X, Y) graphs that display up to 10 object types at the same time in different colors. Graphs shall show object values relative to time. Each trend log shall support a custom scale setting for the graph view that is to be stored continuously. System shall be capable of trending on an interval determined by a polling rate, or change-of-value.

.3 Operator shall be able to change Trend log setup information. This includes the information to be logged as well as the interval at which it is to be logged. All input, output, and value object types in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics on which object is displayed.

.4 System shall include a Trend Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic, and then selecting Trend logs from the displayed menu.

.5 System shall be capable of using Microsoft SQL as the system database.

.6 Any displayed data that is changeable by the operator may be selected using the right mouse button and the trend log shall then be selectable on the screen. Selection of the trend log using this method shall allow the viewing of the trend log view or launch the Trend log wizard to allow the creation of a new trend.

.8 Energy Log Information:

.1 System server shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display all energy log information in standard engineering units (SI).

.2 All data shall be stored in database file format for direct use by third-party programs. Operation of system shall stay completely online during all graphing operations.

.3 Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. System shall support using flow and temperature sensors for energy consumption monitoring.

.4 System shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format, the user shall be able to select a specific period of data to view.

.9 Demand Limiting:

.1 System shall include demand limiting program that includes two types of load shedding. One type of load shedding shall shed/restore equipment in binary fashion based on energy usage when compared to shed and restore settings. The other type of shedding shall adjust operator selected control set-points in an analog fashion based on energy usage when compared to shed and restore settings. Shedding may be implemented independently on each and every zone or piece of equipment connected to system.

.2 Binary shedding shall include minimum of five (5) priority levels of equipment shedding. All loads in a given priority level shall be shed before any loads in a higher priority level are shed. Load shedding within a given priority level shall include two methods. In one, the loads shall be shed/restored in a “first off-first on” mode, and in the other the loads shall be shed/restored in a “first off-last on” (linear) fashion.

.3 Analog shed program shall generate a ramp that is independently used by each individual zone or individual control algorithm to raise the appropriate cooling setting and lower appropriate heating setting to reduce energy usage.

.4 Status of each and every load shed program shall be capable of being displayed on every operator terminal connected to system. Status of each load assigned to an individual shed program shall be displayed along with English description of each load.

.10 Tenant Activity / Sub metering:

.1 System shall include program that monitors after-hours overrides by tenants, logs that data, and generates a bill based on usage and rate charged for each tenant space. Tenant Activity program shall be able to assign multiple zones, from a list of every zone connected to system, to a tenant. Every zone is monitored for after-hour override usage and that data logged in server. Operator may then generate a bill based on the usage for each tenant and the rate charged for any overtime use.

.2 Configuration shall include entry of the following information for use in logging and billing:

.3 Tenant’s contact name and address

.4 One or multiple tenant zones that make up a total tenant space, including a separate billing rate for each separate zone

.5 Minimum and maximum values an event duration and event limit

.6 Property management information

.7 Overall billing rate

.8 Seasonal adjustments or surcharge to billing rate

.9 Billing notification type such including, but not limited to printer, file and email

.10 Billing form template

.11 Logging shall include recording the following information for each and every tenant event:

.1 Zone description

.2 Time the event begins

.3 Total override time

.4 Limits shall be applied to override time

.12 A tenant bill shall be generated for a specific period using all the entered configuration data and the logged data. User with appropriate security level shall be able to view and override billing information. User shall be able to select a billing period to view and be able to delete events from billing and edit a selected tenant activity event's override time.

.11 Reports:

.1 System server shall be capable of periodically producing reports of trend logs, alarm history, device summary, energy logs, and override points. The frequency, content, and delivery shall be user adjustable.

.2 All reports shall be capable of being delivered in multiple formats including text- and comma-separated value (CSV) files. The files can be printed, emailed, or saved to a folder, either on the server hard drive or on any network drive location.

.12 Configuration and Setup:

.1 Provide means for operator to display and change system configuration. This shall include, but not be limited to system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.

.13 Field Engineering Tools:

.1 Operator's workstation software shall include field engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares shall not be acceptable.

.2 User shall be able to select a graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.

.3 Programming tools shall include a real-time operation mode. Function blocks shall display real-time data and be animated to show status of data inputs and outputs when in real-time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.

.4 Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.

.5 Field engineering tool shall include Device Manager for detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number, and description of connected devices. It shall record and display software file loaded into each controller. A

copy of each file shall be stored on the computer's hard drive. If needed, this file shall be downloaded to the appropriate controller using the mouse.

.6 System shall automatically notify the user when a device that is not in the database is added to the network.

.7 System shall include backup/restore function that will back up entire system to selected medium and then restore system from that media. The system shall be capable of creating a backup for the purpose of instantiating a new client PC.

.8 The system shall provide a means to scan, detect, interrogate, and edit third-party BACnet devices and BACnet objects within those devices.

.14 Web Interface:

.1 BAS supplier shall provide Web-based access to the system as part of standard installation. User must be able to access all displays of real-time data that are part of the BAS using a standard Web browser. Web browser shall tie into the network through City-supplied Ethernet network connection. Web page host shall be a separate device that resides on the BAS BACnet network but is not the BAS server for the control system. BAS server must be a separate computer from the Web page host device to ensure data and system integrity. The Web page software shall not require a per-user licensing fee or annual fees. The Web page host must be able to support on average 50 simultaneous users with the ability to expand the system to accommodate an unlimited number of users.

.2 Web pages shall be automatically generated from the BAS displays that reside on the BAS server. User shall access Web page host through the network and shall initiate a Web page generation utility that automatically takes the BAS displays and turns them into Web pages. The Web pages generated shall be automatically installed on the Web page host for access using any computer's standard browser. Any system that requires use of an HTML editor for generation of Web pages shall not be considered.

.3 Web server shall directly communicate to all devices on the BAS network using BACnet protocol. No intermediate devices shall be necessary for BACnet communication.

.4 Browser shall be standard version of Microsoft Internet Explorer v6.0 or later, Firefox v2.0 or later, Google Chrome v 36 or later, and Safari v2.0 or later (on Mac OS X). No special vendor-supplied software shall be needed on computers running browser. All displays shall be viewable, and the Web page host shall directly access real-time data from the BAS BACnet network. Data shall be displayed in real-time and update automatically without user interaction. User shall be able to change data on displays if logged in with the appropriate Username and password.

2.9 DASHBOARD INTERFACE SOFTWARE

.1 General:

.1 BAS supplier shall provide browser-accessed dashboard that can support up to 150 simultaneous users as part of standard installation for viewing of system data on a display, kiosk or personal computer. The dashboard software shall reside on the BAS BACnet network and can share the BAS server for the control system.

.2 Information Display:

.1 Support displaying up to 50 buildings.

.2 User shall be able to navigate by clicking on icons and/or navigate via a touchscreen without the need for any additional configuration.

.3 The dashboard shall support auto rotation of pages to support a display with no user interface (for example, touchscreen, mouse or keyboard). The pages to be displayed can be selected as a subset of all possible pages in the dashboard. The time to view each page and the order in which the pages are cycled through shall be configurable.

.4 The end user shall be able to compare measured data for one entity against measured data for a second entity.

.5 For each resource that is defined (for example: Water, Gas, etc.) one consumption page shall be used.

.6 The dashboard application shall include the following pages at a minimum:

.1 Home page;

.2 Building Layouts and systems page;

.3 Consumption page;

.4 Summary page;

.5 Demand page;

.6 Green facts page; and,

.7 Weather page.

.7 The end user shall be able to view current data on one of the following time scales:

.1 Cumulative data for today, displayed in hour increments;

.2 Cumulative data for the current week, displayed in daily increments;

.3 Cumulative data for the current month, displayed in daily increments; or,

.4 Cumulative data for the current year, displayed in monthly increments.

.8 The user shall be able to see:

.1 Today's data compared against the data for the same day last week;

.2 This week's data compared against the data for the same week last year;

.3 This month's data compared against the data for the same month last year; and,

.4 This year's data compared against the data for last year.

.9 The user shall be able to view historical data in one of the following time scales:

.1 Complete data for yesterday, displayed in hourly increments;

.2 Complete data for last week, displayed in daily increments;

.3 Complete data for last month, displayed in daily increments; or,

.4 Complete data for last year, displayed in monthly increments.

.3 Dashboard Data:

.1 The database for the dashboard shall be on the enterprise network and remotely hosted on a third-party network. The database shall be on-site to maintain security and privacy.

.2 Energy Dashboard data shall reside on site and shall remain in the BAS.

.3 The dashboard shall support Microsoft SQL database.

.4 The dashboard shall allow for the importation of external data via CSV file format.

.4 Browser Technology:

.1 The dashboard shall support Microsoft Internet Explorer, Firefox, Safari, and Google Chrome.

.5 Dashboard Licensing:

.1 The Energy Dashboard shall utilize software licensing that will run in perpetuity, without the need for additional service and/or subscription fees.

.2 No dedicated server or embedded controller shall be needed to host energy dashboard software.

.6 Configuration:

.1 End users shall be able to connect remotely (including dashboard location) to the system to make changes to the configuration using a browser.

.2 Energy Dashboard shall be maintainable by end-user staff with limited training and support common image files including JPEG and PNG.

.3 User generated/supplied content shall include foreground images, background images, text, and icons.

.4 Consumption pages for the resources defined—one (1) for each resource type for which s/he wishes to display consumption data. Consumption data is the total amount of a resource used over time, for example this is a kWh reading.

.5 The system designer shall be able to configure:

.1 One or more home pages.

.2 One or more summary consumption pages. This page shows the total consumption for each configured entity within the system and a total for the entire enterprise.

.3 One or more current demand pages. This page shows the current demand for a given entity.

.4 One or more green facts pages. This page is intended to inform the user of relevant environmental information. It is expected that this type of display will be used in relation to LEED certification.

.5 One or more weather pages using weather station data from NOAA, Environment Canada, or Google.

.6 Support ability to add additional capacity (more buildings, more meters) without the need for additional hardware.

.7 Security:

.1 Dashboard shall have the ability to restrict data behind a firewall or within a demilitarized zone (DMZ).

.2 Dashboard application shall not allow the user to update the system data. For example, the user shall not be allowed to update the present-value of an analog-value.

.3 The dashboard shall require a user authorization via username and password to access the configuration screens.

2.10 OPERATOR WORKSTATION AND LAPTOP

.1 General:

.1 PC based workstation and portable laptop shall reside on high-speed network with building controllers as shown on the Contract Drawings or detailed in the Specification. Each workstation, laptop and/or browser connected to the server shall be able to access all system information.

.2 BACnet Conformance:

.1 Operator Workstation shall be approved by the BACnet Testing Laboratories (BTL) as meeting the BACnet Advanced Workstation requirements.

.2 Operator’s workstation shall as a minimum support Point-to-Point (PTP) and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device. Operator’s terminal shall comply with the requirements of a BACnet

conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:

.1 Clock functional group;

.2 Event response functional group;

.3 Time master functional group, and,

.4 Device communications.

.3 Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

.4 Standard BACnet object types accessed by the workstation shall include as a minimum: Analog Value, Analog Input, Analog Output, Binary Value, Binary Input, Binary Output, Calendar, Device, Event Enrollment, File, Notification Class, Program, and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

.5 The operator's workstation shall comply with Annex J of the BACnet specification for IP connections. Must support remote connection to server using a thick client application. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs). Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network.

.6 Hardware:

.1 Provide operator workstation(s) at locations as shown on the Contract Drawings or described in the sequence of operation.

.2 As minimum, one operator workstation shall be provided for the Project.

.3 Minimum computer requirements:

.1 Intel i7 4770 quad core processor, 3.4 GHz or better.

.2 8 GB RAM.

.3 500 GB hard drive.

.4 ATI Radeon HD graphics card with minimum 1GB DDR3.

.5 23" LCD monitor.

.6 10/100/1000 Ethernet network card.

.7 Keyboard, mouse, DVD-R/W, USB ports, etc.

.8 Microsoft Windows.

.9 Colour Laser printer.

.1 600 dpi

.2 500 Sheets letter size white 24 lb paper

.10 Workstation shall be provided with dedicated UPS, minimum run time 15 minutes, minimum 500W and backup power.

2.11 LOCAL OPERATOR INTERFACE (LOI)

.1 Local operator interface will be achieved by the portable laptop described in clause 2.10 above.

2.12 BUILDING CONTROLLERS:

.1 General Requirements:

.1 BACnet Conformance:

.1 Building Controller shall be approved by the BTL as meeting the BACnet Building Controller requirements and conform to BACnet v1.14.

.2 Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed in section 2.5.2.2. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

.2 Building controller shall be of modular construction such that various modules may be selected to fit the specific requirements of a given project. At a minimum, modules shall consist of a power supply module, a BACnet Ethernet-MS/TP (master slave token passing) module, a BACnet MS/TP-only module, and a modem module for telephone communication. Those projects that require special interfaces may use Modbus modules as needed. However, all Ethernet communications and all controllers—including central plant controllers, advanced application controllers and unitary controllers—supplied by BAS manufacturer shall utilize the BACnet protocol standard.

.3 Modules shall be selected to fit the project application. Up to sixteen (16) modules shall be powered by a single power supply module. All modules shall be panel-mounted on DIN rail for ease of addition and shall be interconnected using a simple plug-in cable. A module in the middle shall be replaceable without removing any other modules.

.4 All modules shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is directly monitored by the building controller module or by another controller. The software program implementing these strategies shall be completely flexible and user-definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a WAN or downloaded through remote communications shall not be acceptable. Changing global strategies using firmware changes shall also be unacceptable.

.5 Programming shall be object-oriented using control function blocks, and support DDC functions, 1500 Analog Values and Binary Values. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.

.6 Building controllers capable of routing MS/TP communication to LAN must have a multi-processor or multi-core architecture. The additional core/processor must be dedicated to processing the BACnet communication processes, allowing the primary to be dedicated to logical processing.

.7 Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator's workstation or field computer.

.8 Controller shall have enough memory to ensure high performance and data reliability. Battery or capacitor shall provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Backup shall maintain real-time clock functions for a minimum of 72 hours.

.9 Global control algorithms and automated control functions shall execute using 32-bit processor.

.10 HMI Display:

.1 Building controllers shall have a compatible, touch-screen HMI panel that will allow for quick viewing of controller points, schedules and alarms.

.2 HMI panel shall be capability of being powered directly by building controller and will not require an additional power supply.

.3 HMI panel shall be mountable either on the DIN rail or on the door of the panel for easy access.

.11 Schedules:

.1 Each building controller module shall support a minimum of 80 BACnet Schedule Objects and 80 BACnet Calendar Objects.

.2 Building controller modules shall provide normal 7-day scheduling, holiday scheduling and event scheduling.

.12 Logging Capabilities:

.1 Each building controller shall log as minimum 500 individual trend logs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.

.2 Logs may be viewed both on-site and off-site using WAN and remote communication.

.3 Building controller shall periodically upload trended data to networked operator's workstation for long-term archiving if desired.

.13 Alarm Generation:

.1 Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.

.2 Each alarm may be dialed out as noted in section 2.3.6.

.3 Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.

.4 Controller shall be able to handle up to 320 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

.14 Demand Limiting:

.1 Demand limiting of energy shall be a built-in, user-configurable function. Each controller module shall support shedding of up to 200 loads using a minimum of two types of shed programs.

.2 Load shedding programs in building controller modules shall operate as defined in sequence of operation and or as per Operator scheduling or override.

.15 Tenant Activity Logging:

.1 Tenant Activity logging shall be supported by a building controller module. Each independent module shall support a minimum of 380 zones.

.2 Ethernet – MS/TP Modules:

.1 Ethernet – MS/TP Module shall support every function as listed under the General Requirements of this section and the following:

.2 All communication with operator's workstation and all application controllers shall be through BACnet. Building controller Ethernet – MS/TP module shall incorporate as a minimum, the functions of a 2-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz) and MS/TP LAN. Ethernet – MS/TP module shall also route messages from all other building controller modules onto the BACnet Ethernet network.

.1 MS/TP LAN must be software-configurable from 9.6 to 76.8Kbps.

.2 The RJ-45 Ethernet connection must accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).

.3 BACnet Conformance:

.1 Ethernet – MS/TP module shall, as a minimum, support MS/TP and Ethernet BACnet LAN types. It shall communicate directly using these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Global controller shall be approved by the BACnet Testing Laboratory (BTL) as meeting the BACnet Building Controller requirements.

.2 All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

.3 The building controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on WANs and CANs and function as a BACnet Broadcast Management Device (BBMD).

.3 MS/TP Modules:

.1 MS/TP Module shall support every function as listed under the General Requirements, of this section and the following:

.2 Building controller MS/TP module communications shall be though BACnet MS/TP LAN to all advanced application and application-specific controllers. MS/TP module shall also route messages to Ethernet - MS/TP module for communication over WAN.

.1 MS/TP LAN must be software-configurable from 9.6 to 76.8Kbps.

.2 Configuration shall be through a RS-232 or LAN connection.

.3 BACnet Conformance:

.1 MS/TP module shall be approved by the BTL (BACnet Testing Laboratory) as meeting the BACnet Building Controller requirements. MS/TP module shall as a minimum support MS/TP BACnet LAN type. It shall communicate directly using this BACnet LAN as a native BACnet device and shall support simultaneous routing functions between all supported LAN types.

.2 Standard BACnet object types supported shall include, as a minimum, Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program, and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

.4 BACnet IP

.1 The building controller shall have capability to comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the local area network (LAN).

.2 Must support interoperability on WANs and campus area networks (CANs), and function as a BACnet Broadcast Management Device (BBMD).

.3 Each controller shall support at a minimum 128 BBMD entries.

.4 BBMD management architecture shall support 3,000 subnets at a minimum.

.5 Shall support BACnet Network Address Translation.

.6 All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

.5 Expansion Ports

.1 Controller shall support two (2) expansion ports.

.2 Combining the two on-board EIA-458 ports with fully loaded expansion ports, the controller shall support six (6) EIA-485 trunks simultaneously.

.3 Expansion cards that mate to the expansion ports shall include:

.4 Dual port EIA-485 card.

.6 Power Supply Modules:

.1 Power supply module shall power up to seven building controller modules. Input for power shall accept between 17¬–30VAC, 47–65Hz.

.2 Power supply module shall include rechargeable battery for orderly shutdown of controller modules including storage of all data in flash memory and for continuous operation of real-time clocks for minimum of 20 days.

.7 Controller shall operate in the following environmental conditions:

.1 -4 to 149 °F (-20 to 65 °C) without optional battery, or 32 to 122 °F (0 to 50 °C) with optional battery.

.2 0 to 95% relative humidity (RH), non-condensing.

.3 If located in panels outdoors and or exceeding environmental conditions, provide self-contained AC units or thermostatic heaters.

2.13 FIELD LEVEL CONTROLLERS

.1 Provide one or more native BACnet application controllers for each air handler and provide native BACnet application controllers as needed for central plant control that adequately cover all objects listed in object list. All controllers shall interface to building controller through either MS/TP LAN using BACnet protocol, or Ethernet LAN using BACnet over Ethernet or BACnet TCP/IP. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident on operator workstation and be the same tool as used for the building controller. No auxiliary or non-BACnet controllers shall be used. MS/TP controllers must have the ability to auto-configure MAC addressing to eliminate possibility of conflicts.

.2 BACnet Conformance:

.1 Application controllers shall be approved by the BTL as meeting the BACnet Advanced Application Controller requirements.

.2 Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

.3 Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Multi-state Values, Device, File, and Program object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

.3 Application controllers shall include universal inputs with 12-bit resolution that accept 20K thermistors, 0–10VDC, 0–5VDC, 4–20mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three inputs that accept pulses. Controller shall include binary and analog outputs on board. Analog outputs with 12-bit resolution shall support 0–10VDC. Binary outputs shall have LED indication of status. Software shall include scaling features for analog outputs. Application controller shall include 20VDC voltage supply for use as power supply to external sensors.

.4 All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller minimum of once per second and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator's terminal.

.5 Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely using modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator's terminal section.

2.14 UNITARY EQUIPMENT CONTROLLERS

.1 Provide one native BACnet application controller for each piece of unitary mechanical equipment (Fan Coils, Heat Pumps, AC Units, VAV box, reheat coils, fans, etc.) that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller through MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.

.2 BACnet Conformance:

.1 Application controllers shall, as a minimum, support MS/TP BACnet LAN types. They shall communicate directly using this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. MS/TP controllers must have the ability to auto-configure MAC addressing to eliminate possibility of conflicts. Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements and support all BACnet services necessary to provide the following BACnet functional groups:

.1 Files Functional Group

.2 Reinitialize Functional Group

.3 Device Communications Functional Group

.2 Please refer to Section 22.2, BACnet Functional Groups in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

.3 Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

.3 Application controllers shall include universal inputs with 10-bit resolution that can accept 20K thermistors, 0–5VDC, 4–20mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall include binary outputs on board with analog outputs as needed.

.4 All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely through modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.

.5 Application controller shall include support for intelligent room sensor. Display on intelligent room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode, based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

.6 On board flow sensor shall be microprocessor-driven and pre-calibrated at the factory. Pre-calibration shall be at 16 flow points as a minimum. All factory calibration data shall be stored in non-volatile memory. Calibration data shall be field adjustable to compensate for variations in VAV box type and installation. All calibration parameters shall be adjustable through operator's workstation, portable computers, or special hand-held field tools.

.7 Provide duct temperature sensor at discharge of each VAV box that is connected to controller for reporting back to operator's workstation.:

2.15 HVAC CONTROL PANELS (HCP)

.1 The maximum width of the panel is to be 900 mm (36 inches), unless space restrictions require a single larger panel.

.2 All wiring within the panel is to be in Panduit. Field wiring is to be terminated at a single terminal strip located on one side of the panel.

.3 A single 120-volt, 20-amp feeder shall serve each HCP, unless otherwise indicated in the Contract Documents. The 120-volt feed shall be brought into a dedicated power panel (HCP Power Panel) housing the UPS, switches, power outlet and 120 to 24-volt transformers. The HCP panel shall be constructed for low voltage (class II) components only. Any non-class II components or wiring shall be contained within the HCP Power Panel.

.4 Each DDC Controller enclosure shall have a standard switched 120/1/60 15A duplex AC power receptacle located within the enclosure to provide power for test equipment, operation, communication devices, etc.

.5 Uninterruptible Power Supply (UPS)

.1 At each HVAC Control System panel, provide as minimum a APC BK500 Uninterruptible Power Supply (UPS) or approved equivalent or as per panel power requirements.

.2 The UPS shall provide backup power to the HVAC Control System for a minimum of 15 minutes under a 100VA load. The UPS shall have the following features:

.1 Power Input 120VAC, NEMA 5-15P

.2 Power Output 120VAC at 350VA/210W/

.3 Six outlets 3at NEMA 5-15R and 3 at NEMA5-15R (Surge).

.4 Surge protection.

.5 Audible alarm on low battery power

.6 Wiring fault indicator.

.7 Power indicator.

.8 Replace Battery indicator.

.9 Overlead indicator

.10 DB9 RS232, USB port for interface.

.6 Provide a 120V/24V fused transformer(s) located within the control panel to power all devices requiring same.

.7 HCP Contents:

.1 HVAC Control System: DDC controllers, UPS, 120V receptacle, on/off switch to isolate panel/receptacle power, fuses, control relays, control switches, transformers, display screens, keypads, and other devices necessary for system. Flush-mount display screens and keypads on front panel face and provide enough gaskets/seals to preserve the panel rating.

.2 Non DDC HVAC Control System: As appropriate to the application but may include set point adjustment dials, gauges, receiver controllers, manual timers, time clocks, microprocessor control modules, electronic indication relays, pilot lights, alarm lights, selector switches. Indicating lights and similar visual display components are to be door mounted. Flush-mount pilot lights, display screens and keypads on front panel face.

.8 HCP Construction:

.1 Construct each HCP to conform to NEMA 250 rating as indicated in the Schedule below, except where indicated otherwise in the Contract Documents:

HVAC Control Panel (HCP) NEMA 250 Construction Schedule	
Location	**NEMA 250 Type**
Indoors (non classified)	**4**
Indoors classified	**Per area classification**
Electrical Room	**12**
Outdoors (incl. outdoor AHUs)	**4x**

.2 Metal enclosures are to accommodate secure conduit fittings and protect against electrical transients.

.3 Hinged front door with locking handle (or locking latch) and key. All panel locks are to be common keyed.

.4 Identify gauges and control devices on the panel face with engraved lamacoid labels with an engraved white-black-white laminated plastic nameplate indicating the function of the instrument. Relays and terminal blocks within the panel shall be identified with plastic slip-on wire markers.

.5 Identify HVAC systems controlled by the controller on the panel face with engraved lamacoid labels with an engraved white-black-white laminated plastic nameplate. Relays and terminal blocks within the panel shall be identified with plastic slip-on wire markers.

.6 All field control and power wiring, panel wiring, equipment terminations or field wiring joints shall be identified by tubular sleeve heat shrink-type or non-heat shrink-type markers as follows:

.1 Wire markers shall be white with black print.

.2 Properly sized as per the manufacture’s recommendations for the type and size of wire/cable.

.3 Labeling shall agree with manufacturer's equipment drawings, control drawings and panel directories.

.4 Shall be CSA/ULC approved for the intended use.

.5 Wire markers shall be Brady "PermaSleeve" wire markers B-319 or B-321 or preapproved equivalent.

.6 Handwritten or adhesive book numbers/letters shall not be acceptable.

.7 Indicating lights on the panel cover shall be minimum 20 mm (3/4-inch) diameter Allen Bradley oil tight push to test lights, with 24 VAC replaceable light bulbs.

.9 Panel Listing: Panel shall bear a CSA listing mark.

.10 Control Devices:

.1 Mount inside HCP unless otherwise indicated in the Contract Documents.

.2 Prewired internally.

.3 Terminate wires leaving HCP at separately numbered terminal strips (one terminal pair per circuit).

.4 Furnish individual connectors for every item of mechanical equipment, integral and remote pilot lights, or other devices described for each panel.

.5 Identify wires by colour coding or numerical tags at both ends.

.6 Wire control devices without splices to the terminal strip.

.7 Furnish integral circuit protection for panel mounted control devices.

.11 Terminal Blocks:

.1 One-piece molded plastic blocks with screw type terminals and barriers rated for 600 volts.

.2 Double sided and supplied with removable covers to prevent accidental contact with live circuits.

.3 Furnish permanent, legible identification, clearly visible with the protective cover removed.

.4 Terminate wires at terminal blocks with crimp type, preinsulated, ring-tongue lugs.

.5 Size lugs for terminal block screws and for the number and size of wires terminated.

.6 Provide screwdriver access for blade width of a minimum of 5 mm for Klein 601 Series screwdrivers. Terminals requiring use of special screwdrivers are not acceptable.

.12 Miscellaneous Accessories:

.1 Furnish panel as-built electrical layout diagrams, secured to the inside of panel door, or enclosed in plastic jackets placed inside each panel.

.2 Provide non-destructible labeling on the inside surface of panel door to indicate the source (panel and circuit breaker number) of power to the panel.

.3 Install plastic or stick-on labels on interior control devices to identify them in conjunction with control schematics.

.4 Provide one spare set of fuses for each fuse type in a fuse holder mounted inside the panel. (Alternate: Provide ABB S200U-K series miniature circuit breakers, or approved equal, mounted on din rail inside of the panel. Provide one circuit breaker for every 4A class II circuit.)

.5 Provide a metal document holder inside the panel.

.6 For outdoor panels provide a thermostatic heater to prevent condensation/ corrosion inside the panels.

2.16 CONTROL VALVES

.1 The valve shall be fit with a fail-safe electric rotary actuator. Fail safe shall be provided by spring return or by internal power supply shall be integral to actuator and designed for one full stroke at the rated torque in the absences of main power. No physical change to the build or construction of the actuator shall be needed to achieve the change in fail safe build. Selection of actuator is to be based on the requirements of the applications and installation location. Actuator shall include manual override, programmable limit switches and double o-ring seal. All valves or dampers marked as NC (normally closed) shall be FS (fail safe) as well, unless otherwise stated or required in the sequence of operation

.2 Provide control valves that are properly sized and selected in accordance with the load requirements and characteristics of the systems to which they are applied.

.3 Valves are to be plug, ball, and/or butterfly, as required by the specific application.

.4 Provide 2-way pressure independent valves throughout or 3-way valves, to suit the application and flow media, as shown on the Contract Drawings.

.5 Two-way Modulating: Non Radiation: Pressure drop equal to the pressure drop through the coil or 27 kPa (4 psi), whichever is greater. Radiation: Pressure drop equal to 7 kPa (1 psi).

.6 Three-way Modulating: Non Radiation: Pressure drop equal to the pressure drop through the coil or 27 kPa (4 psi), whichever is greater. Radiation: Pressure drop equal to 7 kPa (1 psi).

.7 Two position valves shall be line size with full ports.

.8 Leakage: ANSI Class IV

.9 Acceptable Manufacturers: Belimo Air Controls Inc., Johnson Controls Inc., Siemens Canada Inc., or Honeywell International Inc.

.10 13 mm to 50 mm (0.5” to 2”) Valves:

.1 Forged brass body with NPT screw fittings. Minimum valve body rating to be ANSI 250 class.

.2 1379 kPa (200 psi) close-off pressure rating.

.3 Terminal valves shall have chrome plated brass ball and stem (water only). All other valves shall have stainless steel trim.

.4 Provide 500:1 rangeability.

.5 Provide equal percentage characteristics for all modulating services.

.11 65 mm to 150 mm (2.5” to 6”) Valves:

.1 Brass body with iron flanges or cast iron. Minimum valve body rating to be ANSI 150. Provide higher body ratings as required for the water systems when applicable.

.2 690 kPa (100 psi) close-off pressure rating.

.3 Valves shall have stainless steel trim.

.4 Provide 500:1 rangeability.

.5 Provide equal percentage characteristics for all modulating services.

.12 Valve Actuators:

.1 Control Signal: Compatible with controller outputs.

.2 Floating control signal is not acceptable.

.3 Operating Time: Maximum 120 seconds throughout the full rotation.

.4 Mounting: Corrosion resistant hardware.

.5 Stall Protection: Electronic overload or digital rotation sensing.

.6 Fail safe: Non-spring return for radiation and terminal reheat coils; spring return or internal power supply for others. Spring returns to normal position within 15 seconds.

.7 Manual Override: Crank type. External gear release for non-spring return actuators.

.8 Position Indicator: Provide. Indicate valve open and closed positions.

.9 Close-off Pressure:

.1 Water:

.1 Two-way: 150% of total system head.

.2 Three-way: 300% of the pressure differential between ports A and B at design flow, or 100% of total system head.

2.17 PRESSURE INDEPENDENT CONTROL VALVES

.1 Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of the piping system, unless otherwise indicated.

.2 Calibrated balancing valves and automatic flow-control valves shall not be required where pressure independent controls valves are installed.

.3 The control valve shall accurately control the flow from 0% to 100% full rated flow with an equal percentage flow characteristic.

.4 Each control valve shall deviate no more than ±5% through the operating pressure range.

.5 Valve bodies 50mm (2 inch) and smaller shall be brass. Valve bodies 65mm (2.5 inch) through 200mm (8 inch) shall be ductile iron. All internal parts shall be brass, carbon steel, stainless or Teflon®. Plastic internal parts are not acceptable.

.6 Control Valve rangeability shall be 100:1 minimum.

.7 The manufacturer shall warrant all components for a period of 5 years from the date of production.

.8 Fail safe actuator. The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory, or shall be provided with universal mounting plate to allow installation of actuators, meeting system electrical and valve torque requirements.

2.18 CONTROL DAMPERS

.1 General:

.1 Specification applies to control dampers, except those specified to be furnished with equipment.

.2 Furnish opposed-blade type for proportional action and parallel-blade type for two-position action, except where indicated otherwise in the Contract Documents.

.3 T.A. Morrison & Co. Inc. “TAMCO”, Alumavent Inc. or approved equivalent, 100 mm (4 inches) deep, flanged aluminum control dampers with AMCA certified maximum leakage through a 1.2 m x 1.2 m (48 inch x 48 inch) damper.

.4 The damper shall be fit with a fail-safe electric rotary actuator. Fail safe shall be provided by spring return or by internal power supply shall be integral to actuator and designed for one full stroke at the rated torque in the absences of main power. No physical change to the build or construction of the actuator shall be needed to achieve the change in fail safe build. Selection of actuator is to be based on the requirements of the applications and installation location. Actuator shall include manual override, programmable limit switches and double o-ring seal. All valves or dampers marked as NC (normally closed) shall be FS (fail safe) as well, unless otherwise stated or required in the sequence of operation.

.5 Provide mounting installation details and structural reinforcement and/or supports to meet system operational pressures and air flow velocities and /or wind loads for all building envelope installed dampers, and actuator type.

.2 Standard Damper: Tamco Series 1500, Alumavent Series 3165 dampers or approved equivalent complete with:

.1 Leakage through a 1.2 m x 1.2 m (48 inch x 48 inch) damper of 19 L/s/m^2 (3.7 CFM/square feet) against 1 kPa (4 inch w.g.) differential static pressure. Standard air leakage data is certified under the AMCA Certified Ratings Program.

.2 Extruded 6063T5 aluminum frame and blades, each with an integral slot to receive a gasket.

.3 Aluminum end caps press fitted to blade ends.

.4 Extruded silicone frame and blade gaskets secured in an integral slot within the aluminum extrusions.

.5 Slip-proof aluminum and corrosion resistant zinc-plated steel linkage concealed in the frame, equipped with self-sealing and self-lubricating bearings consisting of a Celcon inner bearing fixed on the hexagonal or square blade pin and rotating in a polycarbonate outer bearing inserted in the frame.

.3 Insulated Damper: Tamco Series 9000, Alumavent Series 3965 dampers or approved equivalent complete with:

.1 Leakage through a 1.2 m x 1.2 m (48 inch x 48 inch) damper of 20.92 L/s/m^2 (4.12 CFM/square feet) against 1 kPa (4 inch w.g.) differential static pressure. Standard air leakage data is certified under the AMCA Certified Ratings Program.

.2 Extruded 6063T5 aluminum frame and blades, each with an integral slot to receive a gasket.

.3 Blades are thermally broken and internally insulated with expanded polyurethane foam.

.4 Extruded TPE (Santoprene) side seals and extruded EPDM blade gaskets secured in an integral slot within the aluminum extrusions.

.5 Slip-proof aluminum and corrosion resistant zinc-plated steel linkage concealed in the frame, equipped with self-sealing and self-lubricating bearings consisting of a Celcon inner bearing fixed on the hexagonal blade or square pin and rotating in a polycarbonate outer bearing inserted in the frame.

.4 Acceptable manufacturers are:

.1 T.A. Morrison & Co. Inc. "TAMCO", Alumavent Inc, EB Air, Greenheck, American Warming and Ventilating

2.19 CONTROL DAMPER ACTUATORS:

.1 The damper shall be fit with a fail-safe electric rotary actuator. Fail safe shall be provided by spring return or by internal power supply shall be integral to actuator and designed for one full stroke at the rated torque in the absences of main power. No physical change to the build or construction of the actuator shall be needed to achieve the change in fail safe build. Selection of actuator is to be based on the requirements of the applications and installation location. Actuator shall include manual override, programmable limit switches and double o-ring seal. All valves or dampers marked as NC (normally closed) shall be FS (fail safe) as well, unless otherwise stated or required in the sequence of operation.

.2 Drawings and Control Diagrams indicate only one damper motor for each motorized damper (M).

.3 Select actual quantity of motors required to operate each damper in accordance with the size of damper provided.

.4 Coordinate exact quantity of damper motors with electrical Work to ensure that necessary wiring and conduit is provided for installation.

.5 Provide operators for motorized dampers and motorized louvers for all cases where an operator is not supplied as part of a unit.

.6 Operating Time: Maximum 120 seconds throughout the full rotation.

.7 Angle of Rotation: Adjustable between 0° to 90°.

.8 Stall protection: Mechanical or electronic.

.9 Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire rotation.

.10 Failsafe: Non-spring return for VAV terminals; spring return or internal power supply for other applications. Spring return to normal position within 15 seconds.

.11 Provide quantity of actuators to ensure enough torque for the damper. Total actuator torque must be 20% above the calculated damper torque.

.12 Position Indicator: Reversible for clockwise or counter-clockwise rotation; set the 0 degrees mark to the failsafe position.

.13 Manual Override: Crank type. External gear release for non-spring return actuators.

.14 Provide UL555S listed damper actuators for all dampers used in smoke control.

.15 Approved equivalent actuator manufacturers will be considered only if the two-position actuators proposed have two auxiliary contacts at least one of which shall be an adjustable (between 35 percent and 100 percent open) trip point. The second auxiliary contact will be used to provide feedback to the HVAC Control System for monitoring and alarming purposes. For modulating actuators provide actuator with 0-20mA feedback proportional to damper position. All actuators provided shall be from a single manufacturer.

.16 Provide ample number of actuators and adequate power to overcome friction of damper linkage and air pressure acting on damper blades.

.17 Damper operators are to be selected to provide 20% excess torque for the application. Provide multiple damper operators as required. It is the responsibility of the Contractor under this Section to determine and include for the total number of operators required.

.18 Unless otherwise shown on the Drawings, operators to be provided and set up such that all return air dampers are normally open (fail open) and exhaust and outdoor air dampers fail normally closed (fail closed).

.19 Acceptable Manufacturers: Belimo Air Controls Inc., Johnson Controls Inc., Siemens Canada Inc., or Honeywell International Inc.

2.20 AUXILIARY CONTROL DEVICES:

.1 Intelligent Room Sensor

.1 Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor. Controller shall function as room control unit and allow occupant to raise and lower setpoint and activate terminal unit for override use—all within limits as programmed by building operator. Sensor shall also allow service technician access to hidden functions as described in sequence of operation.

.2 The intelligent room sensor shall simultaneously display room setpoint, room temperature, outside temperature, and fan status (if applicable) at each controller. This unit shall be programmable, allowing site developers the flexibility to configure the display to match their application. The site developer should be able to program the unit to display time-of-day, room humidity and outdoor humidity. Unit must have the capability to show temperatures in degrees Fahrenheit or Centigrade.

.3 Override time may be set and viewed in half-hour increments. Override time countdown shall be automatic but may be reset to zero by occupant from the sensor. Time remaining shall be displayed. Display shall show the word “OFF” in unoccupied mode unless a function button is pressed.

.4 Field service mode shall be customizable to fit different applications. If intelligent room sensor is connected to VAV controller, VAV box shall be balanced and all air flow parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.

.2 Temperature Sensors:

.1 General Requirements:

.2 Temperature sensors shall be of the resistance type, two-wire 1000 ohm nickel RTD, two-wire 1000 ohm platinum RTD or two-wire 20,000 ohm thermistor.

.3 Space Temperature Sensors:

.4 For installation throughout the facility unless otherwise noted.

.5 Space Temperature Sensors with Adjustable Set-Point, Override and Display:

.6 Keypad or slider for temperature set-point adjustment.

.7 LED display.

.8 Timed override request push button with LED status for activation of after-hours operation.

.9 For installation only where indicated on drawings, controls diagrams or sequences of operations.

.10 Covers for Wall Mount Sensors:

.11 Overrides: Exposed set point adjustment and override button.

.12 Communication Port: For communication between Portable Operator Terminals and ASC controllers.

.13 Averaging Temperature Sensors:

.14 Minimum 1.5 m (5 ft) of capillary per 1 sq m (10 sq ft) of duct cross-section.

.15 Provide multiple sensors where single averaging element is unable to be positioned to provide complete duct or plenum traverse.

.16 Outside Air Temperature Sensors:

.17 Outside air temperature sensors shall be designed to withstand the environmental conditions to which they will be exposed.

.18 The sensors shall be provided with a solar shield.

.19 Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

.20 Duct Temperature Sensors:

.21 Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.

.22 Probe length shall be no less than 1/3 of the duct width or diameter.

.23 For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

.24 Thermowells:

.25 Brass or Type 316 stainless steel suitable for the application.

.26 Heat transfer compound compatible with sensing element.

.3 Guards for Sensors and Thermostats:

.1 Materials: Heavy gauge steel.

.4 Relative Humidity Sensors:

.1 Sensors shall have a minimum range of 10% to 90% with an accuracy of +/-2% RH.

.2 Outdoor sensors shall be suitable for a temperature range of -40°C to 75°C (-40°F to 167°F). Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure.

.3 Humidity sensor drift shall not exceed 1% of full scale per year.

.4 Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.

.5 Sensors shall be calibrated to NIST standards.

.5 Binary Temperature Devices:

.1 Low-voltage space thermostat shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed set-point adjustment, 13°C to 30°C (55°F to 85°F) set point range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

.2 Line-voltage space thermostat shall be bimetal-actuated, open contact type, or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listed for electrical rating, concealed set-point adjustment, 13°C to 30°C (55°F to 85°F) set-point range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

.3 Low-limit thermostats: Low-limit airstream thermostats shall be UL listed, vapor pressure type, with an element of 6 m (20 ft) minimum length. Element shall respond to the lowest temperature sensed by any 30 cm (1 ft) section. The low-limit thermostat shall be manual reset only. Limit shall have auxiliary contact for connection to BAS. Thermostat set point range shall be -1°C to 13°C (30°F to 50°F) and set to 1.67°C (35°F).

.4 High-limit thermostats: High-limit airstream thermostats shall be UL listed, vapor pressure type. The high-limit thermostat shall be manual reset only. Thermostat set point range shall be 38°C to 66°C (100°F to 150°F) and set to 57°C (135°F).

.6 Relays:

.1 Control relays shall be UL listed plug-in type with dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

.2 Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable ±200% (minimum) from set point shown on the Contract Drawings. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

.7 Override Timers:

.1 Override timers shall be spring-wound or electronic type, UL Listed, with contact rating and configuration as required by application. Provide 0 to 1 hour override adjustment unless otherwise specified in the Contract Documents. Timer shall be suitable for flush mounting on control panel face or flush mounted on a single gang electrical box.

.8 Transformers:

.1 AC voltage transformers shall be UL/CSA Recognized, 600 VAC rated, complete with built-in fuse protection.

.2 Transformers shall be suitable for ambient temperatures of 4°C to 55°C (40°F to 130°F) and shall provide ±0.5% accuracy at 24 VAC and a 5 VA load.

.3 Windings (except for terminals) shall be completely enclosed with metal or plastic material.

.9 Current Switches:

.1 Current-operated switches shall be self-powered, solid-state with adjustable trip current with LED status indicator and insulation rating of 600 VAC. The switches shall be selected to match the current of the application and output requirements of the DDC system.

.10 Pressure Transducers:

.1 Transducer shall have linear output signal. Zero and span shall be field adjustable.

.2 Transducer sensing elements shall be capacitance sensing type and able to withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.

.3 Water pressure transducer shall have stainless steel diaphragm construction, minimum proof pressure of 1,034 kPa (150 psi). Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.

.4 Water differential pressure transducer shall have stainless steel diaphragm construction, minimum proof pressure of 1,034 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2,068 kPa (300 psi). Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and five-valve manifold.

.11 Pressure Switches:

.1 Differential pressure type switches (air or water service) shall be UL listed, single pole, double throw (SPDT) snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as shown on the Contract Drawings.

.12 CO_2 Sensors

.1 Sensors shall employ non-dispersive infrared technology (NDIR).

.2 Accuracy shall be +/- 75 ppm over 0-1500 ppm range with response time of less than 1 minute.

.3 Sensor shall have 4-20 mA outputs at 20-30 VDC/AC power voltage.

.4 Sensors shall have operating range of 0°C (32°F) to 40°C

.13 Gas Detection System

.1 Gas Detection Controller

.1 Use: Centralized gas detection monitoring with real-time gas reading, selective alarm activation.

.2 Enclosure: MENA 3 for indoor and NEMA 4X for outdoor.

.3 Power Requirement: 90-240VAC, 17-27 Vac, 24-38 Vdc.

.4 Network: Modbus, BACnet

.5 Alarm Levels: Adjustable, LOW, MID and HIGH alarm set-points for each channel

.6 Outputs: Four SPDT relays (alarms and/or fault) dry contact relays rated 5 amps @ 240 VAC or to suit the application.

.7 Buzzer, rated 90 dB @ 30 cm

.8 Display: LCD display, with LED indicators, e.g. “POWER”, “STATUS 1, 2 and 3” and “FAULT”

.9 Operating Humidity Range: minimum range 15-90% RH, non-condensing.

.10 Operating Temperature Range: minimum range -20 to 40°C.

.11 Certifications: CAN/CSA C22.2.

.12 Make and Model: Honeywell 301C, C.E.T. FCS-8, or equivalent.

.2 Wired or Stand-Alone Gas Transmitter:

.1 Use: Wall mounted, wired gas detector transmitter used in conjunction with controller.

.2 Power Requirement: 12-27 Vac, 16-30 Vdc.

.3 Network: Modbus, BACnet

.4 Display: LCD display.

.5 Visual Indicators: Alarm or fault conditions to be displayed on LCD display or LED lights

.6 Audible Alarm: Remote strobe and horn rated 99 dB @ 3 m

.7 Relay Output: One SPDT relay, dry contact relays rated 2 amps @ 30 VAC or to suit the application.

.8 Sensing Technology: Electrochemical sensor or catalytic for combustibles (internal or remote) or solid state for refrigerants (internal) or PID TVOC (remote)

.9 Accuracy: +/- 5%

.10 Pre-calibrated sensors: Provide calibration certificates.

.11 Detection Range: Carbon Monoxide = 0 - 200 ppm; Nitrogen Dioxide (NO2) = 0-10 ppm; Oxygen = (0 - 25% volume); Combustibles = 0-100% LEL;

.12 Certified to: CAN/CSA C22.2

.13 Provide additional cUL/ CSA strobe and horn combination to suit installation area full coverage.

.14 Make and Model: Honeywell E3 Point sensors, C.E.T. LPT or ART, or equivalent.

.14 SO2 detection system:

.1 RS485 MODBUS output fixed point detector with optional programmable relay for the protection of personnel and plant from toxic and hazards.

.2 Incorporating a transmitter with local display and remote mounted sensor, fully configurable via non-intrusive magnetic switch interface with a wide range integral and remote sensors.

.3 Input Voltage Range: 16 to 32Vdc (24Vdc nominal).

.4 Max Power Consumption: Maximum power consumption is dependent on the type of gas sensor being used. Electrochemical cells = 3.7W

.5 Maximum inrush current = 800mA at 24VDC.

.6 Relays: One SPDT dry contact relay, rated 30 volts, 2 amps max, or to suit application.

.7 Communication: RS485, Modbus RTU.

.8 Material: Housing: ABS / Polycarbonate or Epoxy painted aluminum.

.9 Certification: CAN/CSA C22.2.

.10 Operating temperature: 0ºC to +40ºC, or-40ºC to +40ºC, to suit application.

.11 Operating humidity: Continuous 20-90%RH (noncondensing).

.12 Provide duct mounted sensor kit installation for HVAC applications, to suit application.

.13 Make and Model: Honeywell Sencepoint, C.E.T. cGAS sensors or equivalent.

.15 Hydrogen; Flammable; CH4 detection system:

.1 RS485 MODBUS for use with remotely mounted flammable gas sensors 705 and 705HT or equivalent.

.2 Incorporating a transmitter with local display and remote mounted sensor, fully configurable with a wide range integral and remote sensors

.3 Input Voltage Range: 16 to 32Vdc (24Vdc nominal)

.4 Max Power Consumption: 5W

.5 Maximum inrush current = 800mA at 24VDC

.6 Relays: One SPDT dry contact relay, rated 30 volts, 2 amps max, or to suit application.

.7 Communication: RS485, Modbus

.8 Material: Housing: ABS / Polycarbonate or Epoxy painted aluminum. Class 1 Div 1 or Div 2.

.9 Certification: CAN/CSA C22.2.

.10 Operating temperature: -20ºC to +40ºC or to suit application

.11 Operating humidity: Continuous 20-90%RH (noncondensing).

.12 Sensor shall be available for remote monitoring configuration at a distance of up to 15 M from the transmitter with the remote junction box UL/CSA listed as required

.13 Non-intrusive calibration: sensor/transmitters can be calibrated without opening any enclosures. Calibration shall be completed via the local display utilizing magnetic switches. The device shall not use clamp on devices or wireless remote controls to perform calibration or configuration operations. Calibration of the sensor shall be so that only one person is required to complete calibration. Successful calibration must be visually indicated via the unit LCD

.14 Make and Model: Honeywell Sencepoint XCD, C.E.T. LPT sensors or equivalent.

.16 VOC detection system:

.1 Analogue output 4-20mA (opto-isolated), 12-24V

.2 Extremal signal/type: Transistor output (150mA max)/ Low Alarm | High Alarm | Control | Diagnostics

.3 Input Voltage Range: 24V DC, 500mA (range 22-26V DC)

.4 Communication: RS485 (Aeroqual proprietary protocol)

.5 Material: Fibre reinforced polycarbonate | IP41 & NEMA 2 equivalent

.6 Temperature and Humidity sensor: Range -40°C to 124°C (-40°F to 255°F) | Range 0 to 100% RH

.7 LED Display

.8 User configurable alarm set points: (2)

.9 PC Data Logging & Networking Software

.10 Provide duct mounted sensor kit installation for HVAC applications

.11 Sampling method: Active sampling via internal sensor fan

.12 Make and Model: “Aeroqual” s930 sensors or equivalent

.17 Refrigerant detection system:

.1 Provide all labor, materials, products, equipment and service to supply and install a refrigerant detection and control system

.2 Units shall be certified to ULc and CSA standards.

.3 The system shall include, but not be limited to, the following

.1 Future expandability

.2 Display of refrigerant gas concentration

.3 Ability to modify alarm set points

.4 Interlocking with emergency system shut down

.5 Automatic and manual fan start/stop

.6 Display of alarm status

.4 Main controller/ expansion module:

.1 The expansion module shall be installed inside the mechanical room and be capable of communicating digitally with the networked sensors through RS-485 Modbus communication or analog signal(4-20mA). The system shall operate on 24Vac 2A max. The sensor must have at least one relay output rated 30 volts, 2 amps. The main controller must have at least four relay outputs rated 5 amps @ 240 VAC., or to suit application.

.2 The expansion module must provide all the functionalities necessary to comply with current ASHRAE 15 guidelines and CSA B-52 Mechanical Codes. This includes a key for manual fan start/ stop operation, a silence key to acknowledge RFSA 105db horn (audible alarm operation will automatically reset and sound again at the next alarm occurrence), a RED strobe on top of the unit as a visual alarm and (2) inputs for the ‘’EMBG’’ break glass switch for EMERGENCY shutdown.

.3 The Controller/expansion module will indicate the exact concentration of refrigerant gas and the refrigerant gas detected. The controller shall continuously display the specified refrigerant concentration of each sensor via a scrolling LCD screen. The LCD screen will indicate multiple alarm levels for each sensing point.

.4 The alarm ‘Low level’ relay shall be energized, and the first alarm shall be initiated when the refrigerant gas concentration reaches or exceeds the programmed level 1. Alarm ‘Low level’ shall start the mechanical room ventilation equipment and shutdown any combustion equipment in the same mechanical room. Provide hardwired interface and BAS interface. The Alarm ‘Mid Level’ relay shall be energized, and the second alarm shall be initiated when the refrigerant concentration levels reach or exceed the programmed level 2. Alarm ‘Low level’ shall energize the red horn strobe of the controller or a remote alarm horn strobe.

.5 The LED indicators shall also provide visual feedback in the following manner:

.1	Normal Operation:	Green LED
.2	Alarm Level A:	Red LED
.3	Alarm Level B:	Red LED
.4	Failure:	Yellow LED
.5	TX:	Yellow LED

OR (dependent on device)

.6	Alarm	LED	Description
.7	Low-Alarm in low	Status 1 is Red	At least one channel is alarm
.8	Mid-Alarm in mid	Status 1 & 2 are Red	At least one channel is alarm
.9	Hi-Alarm	Status 1, 2 & 3 are Red	At least one channel is in high alarm
.10	Fault	Fault is Red	At least one channel is in Fault

.6 The standard three high/low alarm levels will be complemented with a fault relay.

.7 The Controller/expansion module must provide an individual 4-20mA output per refrigerant sensor (up to twenty) for BAS compatibility.

.5 Remote annunciator entrance Panel:

.1 The remote annunciator panel must be installed outside the mechanical room at the main entrance door and be capable of communicating digitally with the Controller/expansion module, and other annunciator modules and accessories.

.2 The Remote Annunciator Panel will manage relays at fully programmable alarm levels.

.3 The remote panel must provide all the functionalities necessary to comply with Current ASHRAE 15 and CSA B-52 Mechanical Codes.

.1 Red Strobe & horn

.1 Manual push button to activate ventilation "purge" / emergency mode. This push button function shall be latching type. Turning off (disable) the ventilation shall be done by the authorized personnel/ BAS Operator through BAS system or manually at the panel (key).

.2 An additional, manual mode shall be provided inside the mechanical room. Allowing ventilation "purge" / emergency mode start or stop by the personnel inside the mechanical room.

.4 The Remote annunciator panel will indicate the exact concentration of refrigerant gas and the refrigerant gas detected from each sensor. The LCD display screen will indicate multiple alarm levels for each sensing point. The annunciator panel will also provide visual feedback in the following manner:

.1 Normal Operation

.2 Alarm Level A

.3 Alarm Level B

.4 Failure

.5 additional strobe and horn units are to be provided, refer to item #7.

.6 Infrared refrigerant gas sensor:

.1 The sensor will be powered by the 301EM-RFSA Controller/expansion module. The detector shall be of diffusion type with no internal sample pump or filter maintenance required. Refrigerant gas will enter the infrared gas detection chamber according to the diffusion principle. Infrared sensing technology will detect the refrigerant gas by sensing the absorption rate of a specific bandwidth of light.

.2 The gas sensor will have resolution levels of 1 ppm with a standard range of 0-1000 ppm. Temperature and relative humidity variations will have no effect on the unit's accuracy.

.3 The sensor will be capable of operating within relative humidity ranges of 5-95% and temperature ranges of 32oF-100oF (0oC-40oC).

.4 The Unit will be equipped with a NEMA 4X Polycarbonate-ABS impact-resistant enclosure.

.5 The system must provide a menu driven method of checking both zero and span calibrations of the detector; adjustments must be made through the controllers' front panel keyboard. The detectors shall require no periodic maintenance other than yearly zero and span checking with calibrated zero and span gas. Periodic checking or adjustments of the unit shall be capable of being accomplished by one person at the unit location.

.6 Stability- the 30 day zero and span drift shall be less than 1% F.S. without the aid of automatic or manual recalibration. The system shall not require any type of auto-zero techniques in order to maintain stability.

.7 The sensor alarm levels and unit are to be installed in accordance with the following parameters:

TARGET GASES	FIRST ALARM RECOMMENDED SET POINT	SECOND ALARM RECOMMENDED SET POINT	TRANSMITTER LOCATION	RADIUS OF COVERAGE
Refrigerant	250 PPM	500 PPM	300mm (1ft) above the floor	6 Meters (20 feet)

.7 Accessories:

.1 Remote Strobe and Horn – STASR

.1 Provide CSA/ ULc remote suitable for indoor and/ or outdoor installation audible strobe/horn, as applicable

.2 The remote mounted unit shall be rated at 85dba at 10 feet (NEMA 4X enclosure for outdoor)

.3 Provide strobe and horn on each outdoor entrance into the mechanical room and inside the mechanical room to obtain full coverage.

.2 Emergency break glass

.1 Provide emergency breaking glass switches

.8 Break glass manual switches shall be equivalent to Honeywell Analytics, type EMBG

.18 Air Flow Meters / differential pressure:

.1 Provide duct mounted, outdoor air louver or hood mounted or fan inlet air flow measuring stations.

.2 Pressure range and transmitter output to suit application.

.3 Temperature compensated.

.4 Capable of withstanding up to 150 percent of rated pressure without damage.

.5 Each measuring station shall be composed of multiple point measuring probes and a single microprocessor to transmit the output.

.6 Velocity range shall be between 0 m/s to 25 m/s (0 fpm to 4921 fpm).

.7 Accuracy shall be 1% of full scale reading.

.8 Repeatability shall be 0.1% of full scale reading.

.9 Temperature range shall be between -40°C to 80°C (-40°F to 176°F).

.10 Meter shall provide an analog 4-20 mA or 0-10 VDC output signal to the BAS controller.

.11 Acceptable Manufacturers: Veltron DPT, Ebtron Inc., Hybrid Series and Sensocon Inc.

.12 Space Air Static Differential Pressure: MAMAC Systems Inc. or Setra transmitter.

.13 Transmitters shall be certified for the air classification they serve (e.g. for air exhaust from electrically classified area, transmitter certification shall be the same or higher)

2.21 FLOW ELEMENTS

.1 Manufacturers:

.1 Fan Inlet: Air Monitor Corporation VOLU-probe/FI, Tek-Air TFP Series or approved equivalent.

.2 Duct: Air Monitor Corporation VOLU-probe, Sensocon JFMS with A3 display or approved equivalent.

.2 Provide fan inlet airflow traverse probe mounted in the fan inlets capable of continuously measuring the air handling capacity (air volume) of the respective centrifugal fans.

.3 The probes shall contain multiple total and static pressure ports along the exterior surface of the cylindrical probes and internally connected to their respective averaging manifolds. Sensors shall not be adversely affected by particle contamination normally present in building system airflows.

.4 The fan inlet air flow traverse probes shall have dual end support swivel brackets suitable for mounting in the fan inlet bell and symmetrical averaging signal takeoffs and fittings and shall be of aluminum construction with hard anodized finish.

.5 The fan inlet airflow traverse probes shall not induce a measurable pressure drop, nor shall the sound level with the system be amplified by its presence in the fan inlet bell.

.6 For ductwork applications, provide an array of air flow probes arranged to measure the air flow across equal representative areas of the duct cross section, complete with flow straighteners to ensure stable flow measurement.

.7 The probes shall be capable of producing steady, non-pulsating signals of total and static pressure, without need for flow corrections or factors, with an overall accuracy of +/-3 percent (1 percent for duct sensors) of actual flow over a fan operating range of 6 to 1 capacity turndown.

.8 Velocity pressure transmitter shall be selected to suit the system working pressures.

.9 Check Mechanical Shop Drawing Schedules to determine whether fans are DWDI type requiring a set of offset mounted fan inlet air traverse probes and interconnected signal tubing.

.10 Install static pressure fittings for duct-mounted differential pressure sensors and switches at a right angle to the flow.

.11 Transmitters shall be certified for the air classification they serve (e.g. for air exhaust from electrically classified area, transmitter certification shall be the same or higher)

2.22 WATER FLOW METERS (ELECTROMAGNETIC)

.1 Provide electromagnetic insertion or flanged meters.

.2 Meters to be accurate to +/-1% of flow reading between 2 ft/s and 20 ft/s.

.3 Meter shall provide an analog output for flow rate, a contact closure to indicate flow direction and separate pulse outputs to totalize forward and reverse flows.

.4 Liquid temperature range from -9 Deg C to 121 Deg C. Ambient temperature range from -11 Deg C to 65 Deg C.

.5 Standard of acceptance: Onicon F-3500 or approved equal

2.23 WATER FLOW METERS (DOMESTIC WATER)

.1 Provide Neptune TRU/FLO compound water meters.

.2 Measurement element AW WA Class II turbine hydrodynamically balanced rotor.

.3 Meters available in 2”, 3”, 4” and 6”.

.4 Two magnetic-driven roll-sealed registers

.5 Maximum operating pressure is 1034 kPa. Maximum operating temperature is 27 Deg C. (Note: if hot water metering is required, install water meter on the cold side feeding the hot water tank and/ or heat exchanger)

.6 Provide Tricon series or E-Coder series pulse and analog transmitters for connection to BAS.

.7 Standard of acceptance: Neptune or approved equal

2.24 GAS METER (DIAPHRAGM)

.1 Provide diaphragm gas meters as shown on the drawings for fiscal monitoring of gas consumption on specific buildings and equipment.

.2 Meter to come complete with die-cast aluminum case, oil-impregnated, self-lubricating bushings, molded convoluted diaphragms, rigid reinforced flag rods, graphite filled phenolic valves to minimize wear, long life low friction grommet seals and high solids polyurethane topcoat.

.3 Meter to provide temperature compensation for gas consumption.

.4 AMR/AMI compatible.

.5 Meter to conform to ANSI B109.1 specifications.

.6 Provide meter to suit gas pressure at location.

.7 Provide pulse kit for connection to BAS. Meter manufacturer to provide pulse information to BAS contractor.

.8 Standard of Acceptance: Canadian Meter (Line Process Control), QMC

2.25 GAS METER (THERMAL MASS FLOW)

.1 Provide thermal mass flow gas meters as shown on the drawings for non-fiscal monitoring of gas consumption on specific buildings and equipment.

.2 Meters shall be inline style, constructed of 316 stainless steel, and complete with user interface/display.

.3 Flow accuracy of meters to be:

.1 +/- 1% of reading from 2.54 – 35.56 m/s (500 - 7,000 SFPM).

.2 +/- 2% of reading from 0.508 – 2.54 m/s (100 – 500 SFPM).

.4 Temperature accuracy of meters to be +/- 0.5°C (1°F) over the range of -40°C to 121°F (40°F to 250°F).

.5 Meters shall be suitable for installation across a range of pipe sizes, 19 mm to 150 mm (¾ in. to 6 in.).

.6 Maximum pressure drop caused by meter at 12.7 m/s, 21C, and 13.8 kPa (2500 FPM, 70F, and 2 PSIG) shall not exceed:

.1 125 Pa (0.5” WC) in pipes 50 mm (2”) and larger.

.2 225 Pa (0.9” WC) in pipes less than 50 mm (2”).

.7 Meter shall provide an analog 4-20 mA or 0-10 VDC output signal to BAS controller.

.8 Approvals: FMc (CAN)

.1 Class 1, Div 1, Groups B, C, D;

.2 Class 2, Div 1, Groups E, F, G;

.3 Class 3, Div 1; T4, Ta = -40°C to 70°C;

.4 Class 1, Zone 1, AEx/Ex db IIB = H2 T4; Gb Ta = -40°C to 70°C;

.5 Type 4X, IP66/67;

.9 Standard of Acceptance: Onicon F-5500 or approved equal.

2.26 THERMAL (BTU) METER:

.1 Provide thermal (BTU) meters as shown on the drawings.

.2 Meters shall be suitable for thermal energy measurements in chilled water, hot water, and condenser water system and consist of a flow meter, two temperature sensors, and a user interface/display.

.3 Flow meter shall be equal to “Water Flow Meter (Turbine)” specified in this section.

.4 Temperature sensors shall be thermistors or resistance temperature detectors (RTDs). Probe material shall be stainless steel, and suitable for installation inside water piping (via thermowell):

.1 Temperature Accuracy: +/- 0.1°C (0.15°F)

.2 Fluid Temperature Range: -3.9°C (25°F) to 150°C (260°F)

.5 Control Panel:

.1 Suitable for installation in ambient temperatures of -28.8°C (-20°F) to 60°C (140°F).

.2 Enclosure to meet or exceed NEMA 2 rating.

.3 Input power shall be either 24 VAC, 60 Hz, 12 VA or 120 VAC, 60 Hz, 15 VA. Contractor to coordinate final power requirement.

.4 Meter shall be capable of providing 4 output signals: Energy rate, Flow rate, Supply temperature, and Return temperature

.5 Meter shall provide analog 4-20 mA or 0-10 VDC output signals to BAS controller.

.6 Approvals: ULc Listed.

.7 Standard of Acceptance: Onicon System-10 BTU Meter or approved equal.

2.27 CURRENT SENSORS (CS):

.1 Fixed Setpoint, Digital Output Current Switch:

.1 Manufacturer: Veris Industries Inc.; Hawkeye 600/800, Greystone Energy, Or approved equivalent

.2 Application: Monitoring status of direct drive equipment.

.3 Current-operated solid state relay.

.4 Split core design.

.5 Trip Setpoint: Fixed.

.6 Output: Digital switch.

.7 Sensor Power: Induced from line.

.2 Adjustable Setpoint, Digital Output, VFD Current Switch:

.1 Manufacturer: Veris Industries Inc., Hawkeye 904, Or approved equivalent

.2 Application: Monitoring status of belt-drive or direct-drive equipment controlled by a VFD.

.3 Microprocessor-based current-operated solid state relay.

.4 Automatic compensation for VFD frequency and current changes.

.5 Split core design.

.6 Trip Setpoint: Self-calibrating.

.7 Output: Digital switch, with normal and alarm status LED.

.8 Sensor Power: Induced from line.

2.28 TIMER/ PUSHBUTTON STATIONS

.1 Provide NEMA 12 panel complete with recessed or surface-mounted “on” and “off” stationary or momentary pushbuttons/contacts, to suit the sequence of operation, LED feedback lamp on outer surface of panel.

.2 LED shall go on when ‘on’ pushbutton is pressed, visual indication.

.3 If timer is activated the LCD display shall “blink”, indicating timer operation.

.4 The ‘OFF’ pushbutton, when pressed, shall override the time remaining and stop the system. LED is “off”.

.5 Provide non-wear, securely fastened signage next to each pushbutton station.

2.29 DUCT SMOKE DETECTORS

.1 Provide CSA certified devices. Photoelectric type, operating on the light scattering principle. Solid state and virtually sealed to prevent being influenced by dirt, dust or humidity. There shall be no moving parts or components that can wear out. Circuitry shall be protected against electrical transients and electromagnetic interference and damage to detector due to polarity reversal or fault on circuit wiring.

.2 Detector shall be able to withstand air-gusts up to 15 m/sec velocity, have a fine 30-mesh insect screen and be completely sealed at back to prevent entry of dust, moisture and air turbulence. Totally shield electronics of unit to protect against false alarms due to EMI and RFI.

.3 Detectors shall be easily disassembled for cleaning, servicing and installation. Installation wiring wired to base only, thus when removing head for maintenance or cleaning no wiring is disturbed. Indicate with LED light to signal operation of unit, facilitating easy viewing from room entry point, glow continuously or rapid flash to indicate alarm condition and able to operate remote lamp or LED. Locking screw on each head will prevent unauthorized removal of head from base.

.4 Consisting of spot type addressable smoke detector and air-tight housing assembly, mounted on side of duct, accommodating sampling tubes which extend into and across ventilating duct.

.5 Provide one air-sampling tube length to suit width of duct and air exhaust tube with proper alignment of tubes using mounting plate.

.6 While fans are operating, continuous cross-sectional sampling of air flows from ventilation duct through detector and return to duct. Air stream range from 18 m/sec maximum velocity to 2.5 m/sec minimum air velocity.

.7 Provisions to check detector sensitivity under actual air-flow conditions, while detector is mounted in its permanent position.

.8 Incorporate indicating latched or rapid flashing LED to signal operation of unit, facilitating easy viewing from room entry point.

.9 Provide dual relay outputs for interface with multiple independent systems.

2.30 VARIABLE FREQUENCY DRIVES

.1 Variable Frequency Drives: provide variable frequency drives for ALL mechanical equipment indicated on the drawing schedules and/or on the control drawings.

.2 For VFD requirements refer to Section 20 08 00

2.31 STARTERS

.1 120 V Motor Starters: Provide NEMA rated breaker type magnetic starters in a NEMA 4 enclosure with the following characteristics:

.1 Suitable for 120 Volts single phase supply having an available fault level of 10kA

.2 Sized for motors characteristics

.3 Control circuit protected by breaker

.4 Separate enclosure for each starter

.5 Engraved lamicoid nameplate identifying load and power source

.6 Solid state over load and other HVAC control relays.

.7 Accessories (Current sensing device with 4-20 mA output, door mounted H-O-A switch (with auxiliary contacts) and push to test type run and fault LED lights, auxiliary contacts timers and relays) to satisfy interlocking and automatic control requirements.

.8 Identified control wiring, terminal block and control devices.

.9 Drawing pocket

.2 600 V Motor Starters: Provide NEMA rated breaker type Full Voltage Non Reversing type combination starters in a NEMA 4 enclosure with the following characteristics:

.1 Suitable for 600 Volts three phase supply having an available fault level of 40kA

.2 Sized for motors characteristics

.3 Fused oversized control transformer

.4 Separate enclosure for each starter

.5 Engraved lamicoid nameplate identifying load and power source

.6 Solid state over load and other HVAC control relays.

.7 Accessories (Current sensing device with 4-20 mA output, door mounted H-O-A switch (with auxiliary contacts) and push to test type run and fault LED lights, auxiliary contacts timers and relays) to satisfy interlocking and automatic control requirements.

.8 Identified control wiring, terminal block and control devices.

.9 Drawing pocket

.3 Coordinate with Division 26 all interface, wiring diagrams, current sensors, HOA switches etc. required to obtain a complete control system.

2.32 HYDROSTATIC WATER LEVEL (SUMPS)

.1 Provide Endress+Hauser FMX21

.2 Probe tube 316L SS

.3 Output 4-20 mA

.4 Voltage: 10 to 35V

.5 Temperature range -10C to +70C

.6 Range: to suit application

.7 Reference accuracy: 0.2%

.8 CSA / FM approved

.9 Provide guide tube, mounting clamp, terminal box and all other installation accessories to suit the application.

2.33 MISCELLANEOUS DEVICES

.1 General:

.2 RTD to voltage (0- to 5-volt) converters with zero span adjustments for use with analog inputs.

.3 Limited range thermistors are acceptable provided they sense expected range for point at specified accuracy with 0- to 5-volt output.

.4 Motor starters.

.5 Auxiliary contacts in each motor starter.

.6 START/STOP relay module for either momentary or maintained switch action as indicated in the Contract Documents.

.7 Pilot Relays:

.1 Plug-in type.

.2 Interchangeable.

.3 Mounted on a circuit board.

.4 Wired to numbered terminal strips.

.8 Motorized Step Controllers: Furnish with adjustable (from -17 degrees C to -12 degrees C) deadband between heating and cooling functions.

.9 Manual Timer (MT):

.1 Manufacturers: M.H. Rhodes-Marktime Inc; Dayton Electrical Manufacturing Co; Broan-Nutone LLC.

.2 12-hour, SPST, 120-volt, 20-amp.

.3 Spring wound.

.4 HOLD feature to override the time clock during off-hour operation.

.5 Install on front cover of HCP.

.10 Electronic Indication:

.1 Furnish temperature-indicating dials or digital read-outs on HCP.

.2 65 mm minimum rectangular.

.11 Strobe/ Horn:

.1 Furnish CSA / UL approved strobe & horn assembly, multi-mode visual/ audio signaling device in a single, integrated stack.

.2 Colour lens according to City requirements.

.3 24 VAC, 24 VDC and /or 120 VAC.

.4 Edwards Signaling 200 Class 70mm ClearView and/ or 105XBRM Series or equivalent.

.12 Corrosion resistance

.1 All devices installed in corrosive or humid air stream shall be suitable for the application.

2.34 WIRING AND RACEWAYS:

.1 Wiring and raceways shall be provided in accordance with the requirements of Division 26 - Electrical.

.2 Raceways, metal flex and liquid tight flex as required for the project and shall be provided in accordance with the requirements of Division 26 - Electrical.

.3 Outlet boxes: shall be provided in accordance with the requirements of Division 26 - Electrical.

.4 Junction boxes: Sized according to number, size and position of entering raceway; type: suitable for the environment. Shall be provided in accordance with the requirements of Division 26 - Electrical.

.5 Provide FT6 plenum rated cable in ceiling plenums and FT4 in conduit for all other cases.

3 Execution

3.1 EXAMINATION

.1 The Contract Drawings shall be thoroughly examined for control device and equipment locations.

.2 The Mechanical Contractor shall inspect the site to verify that equipment may be installed as shown on the Contract Drawings and coordinate with other trades to ensure equipment can be installed where shown on the Contract Drawings.

.3 Any discrepancies, conflicts, or omissions shall be reported to the Contract Administrator for resolution before rough-in work is started.

.4 Refer to clause 1.4-B.

3.2 PROTECTION

.1 The Controls Contractor shall protect all work and material from damage by his/her work or employees and shall be liable for all damage thus caused.

.2 The Controls Contractor shall be responsible for his/her work and equipment until final inspection, commissioning, and acceptance. The Controls Contractor shall protect any material that is not immediately installed. The Controls Contractor shall close all open ends of work with temporary covers.

3.3 COORDINATION

.1 Site:

.1 Where the mechanical work will be installed near, or will interfere with, work of other trades, the Mechanical Contractor shall assist in working out space conditions to make a satisfactory adjustment. If the Controls Contractor installs his/her work before coordinating with other trades, to cause any interference with work of other trades, the Controls Contractor shall make the necessary changes in his/her work to correct the condition with no extra charge to the City.

.2 Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.

.3 Integrate and coordinate work under this section to controls and control devices provided or installed by others. Mechanical Contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

.4 Refer to clause 1.4-B.

.2 Scheduling:

.1 Coordinate with the Mechanical, Electrical and Contractor to ensure submittals are submitted in accordance with the project schedule.

.2 Ensure work is coordinated amongst trades and completed in accordance with the project schedule.

.3 Provide a list of dependencies (by other trades) that are required for controls to be completed. List shall be provided to ensure that scheduling of other trades will allow ample time for controls to complete their deliverables.

.3 Testing and Balancing:

.1 The Controls Contractor shall furnish a single set of all tools necessary to interface to the control system for testing and balancing purposes.

.2 The Controls Contractor shall provide training in the use of these tools. This training shall be planned for a maximum of 4 hours.

.3 In addition, the Controls Contractor shall provide a qualified technician to assist in the test and balance process, until the first 5 terminal units are balanced.

.4 The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

.4 Coordination of Controls Specified in Other Sections or Divisions:

.1 Other Sections and/or Divisions include controls and control devices that shall be part of or interfaced to the control system specified in this Section. These controls shall be integrated into the system and coordinated by the Controls Contractor as follows:

.1 All communication media and equipment shall be provided as specified in Part 2, “Communication” of this Section.

.2 Each supplier of a control’s product shall be responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in Section 25 95 00 – Sequence of Operations series.

.3 The Mechanical, Electrical or Contractor shall coordinate and resolve any incompatibility issues that arise between the control’s products provided under this Section and those provided under other Sections or Divisions.

.4 The Equipment Provider shall be responsible for providing a suitable interface to the BAS. Suitable interface could be a BACnet interface or hard wired points but shall be as described in the Contract Documents.

.5 Refer to clause 1.4-B.

3.4 DELIVERABLES

.1 Provide a fully functioning and complete building automation system as described in the Contract Documents.

.2 Drawings and Documentation:

.3 Provide shop drawings, installation drawings and as built (record) drawings for the project. Provide O&M manuals for the system and all devices.

.4 Operator Interface:

.1 Provide an operator workstation for the project, complete with a fully programmed operator interface software package as described in Part 2. Provide a web based graphical operator interface.

.2 Graphics shall be provided as described below:

.1 Provide an overall building layout to initialize the navigation through the various graphics. Overall layout shall include overview information related to scheduling and energy consumption in the building.

.2 Provide floor plans for each floor or area. Operator shall be able to switch between various floor plan views as applicable to obtain different information. In all views the floor plans shall provide navigational links to individual control systems. Various floor plans to include: 1) Thermal graphics, 2) Equipment location, 3) Lighting, 4) Energy consumption.

.3 Provide individual graphics for each system in the facility. Individual graphics shall include all I/O points for the system, various control carousels as applicable for operator control of the system and dynamic animated graphics (moving fans, dampers, etc.). Graphics shall also contain links to all associated system for quick access to heating/cooling plants, air handling units, VFD's and/or pumping systems. Individual graphics shall also contain energy consumption data where available.

.4 Provide 8 hours of field work dedicated to developing custom dashboards (graphics) with the City and City's Operator. Time shall allow for custom dashboard generation to enable the City/Manager/Operator access to intuitive dashboards to key information they require.

.5 Refer to clause 1.4-B.

.5 Facility Scheduling:

.1 Provide 4 hours of field work dedicated to setting up time schedules and optimal start/stop programs with the City.

.6 Alarm Monitoring and Annunciation:

.1 Set up alarms as described in Section 25 95 00 – Sequence of Operations series for each system.

.2 Provide 4 hours of field work dedicated to setting up alarms with the City. Set up shall implement the City's method for monitoring, annunciating and handling alarms.

.7 Trends and Record Keeping:

.1 Set up trends as described in Section 25 95 00 – Sequence of Operations series for each system.

.2 Provide 4 hours of field work dedicated to setting up trends with the City. Set up shall include establishing and storing trend information for systems as required by the City.

.8 Demand Limiting and Energy Consumption:

.1 Set up interaction for energy optimization between systems as described in Section 25 95 00 – Sequence of Operations series.

.2 Provide 4 hours of field work dedicated to ensuring all demand limiting and energy conservation strategies are set up according to the City's energy plan.

.9 All work with the City as described above shall be provided after training to ensure the City is familiar with concepts and has a plan in place that can be executed by the Controls Contractor.

.10 Provide all controllers and devices as required to deliver a fully functioning BAS as described in this Section and Section 25 95 00 – Sequence of Operations series.

.11 Provide all wiring and installation of supplied devices (except those devices installed by other trades).

.12 Provide all programming, verification and start up required.

.13 Provide all training as described in this Section.

.14 Provide warranty services as described in this Section.

3.5 GENERAL WORKMANSHIP

.1 Install all controllers, cabinets, control devices and power supplies in readily accessible locations providing adequate ambient conditions for its specified application and to the Canadian Electrical Code.

.2 Install products to manufacturer's installation instructions.

.3 Install parallel to building walls and floors unless indicated or specified or required by manufacturer's installation instructions.

.4 Mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

3.6 FIELD QUALITY CONTROL

.1 All work, materials, and equipment shall comply with the rules and regulations of applicable local, provincial, and federal codes and ordinances as identified in Part 1, "References" of this Section.

.2 Controls Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

.3 Controls Contractor shall have work inspected by local and/or provincial authorities having jurisdiction over the work as required.

3.7 WIRING AND CONDUIT

.1 Provide and install all control and interlock wiring in compliance with national and local electrical codes, as well as Division 26.

.2 Where the requirements of this Section differ from those in Division 26, the requirements of Division 26 shall take precedence.

.3 All Class 1 (line voltage) wiring shall be installed in rigid galvanized steel conduit (TRGSC) or Electric Metallic Tube (EMT) conduit with metal flex, as per Division 26.

.4 All wiring in mechanical, electrical, telephone, parking garage, between floors and/or where subject to mechanical damage shall be rigid galvanized steel conduit (TRGSC) or Electric Metallic Tube (EMT) conduit with metal flex, as per Division 26 with metal flex.

.5 All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be fused when required to meet Class 2 current limit.)

.6 Where Class 2 wires are in concealed and accessible locations, including ceiling return air plenums, approved FT6 cables not in raceway may be used.

.7 Class 2 wiring in raceway containing Class 1 wiring shall not be installed. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two (for example, relays and transformers).

.8 Wiring in raceway containing tubing shall not be installed.

.9 Exposed wiring will not be accepted. Conduit shall run parallel or perpendicular to the building walls.

.10 Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.

.11 All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

.12 All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

.13 Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

.14 Size of raceway and size and type of wire shall be the responsibility of the Controls Contractor, in keeping with the Manufacturer's recommendations and electrical code requirements, except as noted elsewhere in the Contract Documents.

.15 Include one pull string in each raceway 2.5 cm (1 in.) or larger.

.16 Use coded conductors throughout with conductors of different colors.

.17 Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on flexible duct strap or tie rods. Raceways shall not run on or be attached to ductwork.

.18 Adhere to Division 26 requirements where raceway crosses building expansion joints.

.19 Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.

.20 The Controls Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

.21 Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Liquid tight flex shall be used where exposed to moisture.

.22 Raceway shall be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations shall be made with fittings at boxes and ends not terminating in boxes shall have bushings installed.

.23 Install control and interlock wiring separate from power wiring.

.24 Number code or colour code conductors, excluding those used for individual zone controls, appropriately for future identification and servicing of control system.

.25 Provide wire markers on each conductor in the panel and at load connections. Identify circuit with control wire number.

.26 Restrain wiring in control panels by plastic ties or ducts.

.27 Hinge wiring shall be secured at each end so that any bending or twisting will be around longitudinal axis of wire and bend area shall be protected with sleeve.

.28 Arrange wiring neatly, cut to length, and remove surplus wiring. Provide abrasion protection for any wire bundles that pass through holes or across edges of sheet metal.

.29 Use the manufacturer's recommended tool with proper sized anvil for crimp terminations. No more than two wires may be terminated in single crimp lug and no more than two lugs may be installed on single screw terminal

3.8 IDENTIFICATION OF HARDWARE

.1 All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 5 cm (2 in.) of termination with the DDC address or termination number.

.2 Permanently label or code each point of field terminal strips to show the instrument or item served.

.3 Identify control panels with minimum 1 cm (0.5") letters on laminated plastic nameplates.

.4 Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.

.5 Identify room sensors relating to terminal box or valves with nameplates.

.6 Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.

3.9 CONTROLLERS

.1 Provide a separate controller for each AHU, Chiller, Boiler, or other HVAC system. A DDC controller may control more than one system provided that the second system is a minor system (EF, RHC, etc.) and all points associated with the system are assigned to the same DDC controller. Points used for control loop reset, such as outside air or space temperature, are exempt from this requirement. Where equipment is provided/ needed for redundancy, controllers are to maintain the level of redundancy of the equipment they serve. Controllers should be considered as a single point of failure, and one controller should not serve both the base, and redundant equipment.

.2 Field Controllers shall be selected to provide capacity for future equipment (1 addition boiler and 1 additional chiller/ air source heat pump) as well as a minimum of 20% spare I/O point capacity for each point type found at each location. If input points are not universal, 20% of each type is required. If outputs are not universal, 20% of each type is required. A minimum of one spare is required for each type of point used. VAV and Terminal Unit controllers are excluded from the spare points requirements.

.3 Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional controller boards or point modules shall be required to implement use of these spare points.

.4 Building Controllers shall allow an additional 20% capacity without the need for additional building controllers.

3.10 INSTALLATION OF SENSORS

.1 Install sensors in accordance with the Manufacturer's recommendations.

.2 Mount sensors rigidly and adequately for the environment within which the sensor operates.

.3 Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing. Room temperature sensors shall be mounted at 1,220 mm (48") above finished floor (confirm with the Contract Administrator prior to installation).

.4 All room temperatures sensors installed against an exterior surface shall be provided with insulated backing.

.5 All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

.6 Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

.7 Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m of sensing element for each 1 m2 (1 ft of sensing element for each 1 ft2) of coil area.

.8 All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

.9 Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.

.10 Differential Air Static Pressure:

.1 Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.

.2 Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.

.3 Building Static Pressure: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover.

.4 The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.

.5 All pressure transducers shall be mounted in a location accessible for service.

.6 All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee.

3.11 PROGRAMMING

.1 Provide enough internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.

.2 Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

.3 Software Programming:

.1 Provide programming for the system and adhere to the sequences of operation provided in Section 25 95 00 – Sequence of Operations series. All other system programming necessary for the operation of the system, but not specified in this Section, shall be provided by the Controls Contractor. Imbed into the control program enough comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:

.1 Text-based:

.1 Must provide actions for all possible situations;

.2 Must be modular and structured; and,

.3 Must be commented.

.2 Graphic-based:

.1 Must provide actions for all possible situations; and,

.2 Must be documented.

.4 Operator Interface:

.1 Standard graphics: Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as set points.

.2 On top of individual graphics, show terminal equipment information on a “graphic” summary table. Provide dynamic information for each point shown.

.3 The Controls Contractor shall provide all the labour necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this Section and Section 25 95 00 – Sequence of Operations series. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.12 CONTROL SYSTEM CHECKOUT AND TESTING

.1 Start-up Testing: All testing listed in this Section shall be performed by the Controls Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the City’s Representative is notified of the system demonstration.

.1 The Controls Contractor shall furnish all labour and test apparatus required to calibrate and prepare to service all instruments, controls, and accessory equipment furnished under this Section.

.2 Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

.3 Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to the Manufacturers’ recommendations.

.4 Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

.5 Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start, and span are correct, and that direction and normal positions are correct. The Controls Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Controls Contractor shall make any necessary adjustments to valve stem and damper blade travel.

.6 Verify that all hardwired safety devices (freezestats, high pressure, etc.) are functional and protect the equipment when it is operating in both the ‘hand’ and ‘auto’ modes.

.7 Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum start/stop routines.

.8 Alarms and Interlocks:

.1 Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

.2 Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

.3 Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.13 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

.1 Demonstration:

.1 Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this Section. These tests shall occur after the Controls Contractor has completed the installation, started up the system, and performed his/her own tests.

.2 The tests described in this Section shall be performed in addition to the tests that the Controls Contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the “Control System Checkout and Testing” article in Part 3 of this Section. The Contract Administrator shall be present to observe and review these tests. The Contract Administrator shall be notified at least 10 days in advance of the start of the testing procedures.

.3 The approved checklists and forms shall be completed for all systems as part of the demonstration.

.4 The Controls Contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Controls Contractor.

.5 As each control input and output is checked, a log shall be completed showing the date, technician’s initials, and any corrective action taken or needed.

.6 Demonstrate compliance with Part 1, Part 2, Part 3 of the specification.

.7 Demonstrate compliance with sequences of operation through all modes of operation.

.8 Demonstrate operation of operator interface.

.9 Additionally, the following items shall be demonstrated:

.1 DDC loop response: The Controls Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop’s response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Controls Contractor.

.2 Demand limiting: The Controls Contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over a minimum 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of trendable equipment outputs.

.3 Optimum start/stop: The Controls Contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.

.4 Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the Contract Administrator. These logs shall cover three 48-hour periods and have a sample frequency of maximum 10 minutes. The logs shall be provided in electronic form (PDF format).

.10 Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The Controls Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests, with no extra cost to the City.

.2 Acceptance:

.1 All tests described in this Section shall have been performed to the satisfaction of both the Contract Administrator, LEED third party commissioning agent, and the City prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the Controls Contractor may be exempt from the completion requirements if stated as such in writing by the Contract Administrator. Such tests shall then be performed as part of the warranty.

.2 The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved by the Contract Administrator and in accordance with Part 1, “Submittals”.

3.14 CLEANING

.1 The Controls Contractor shall clean up all debris resulting from his/her activities on a daily basis. The Controls Contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location on site.

.2 At the completion of work in any area, the Controls Contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, debris, etc.

.3 At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas with no extra cost to the City.

3.15 TRAINING

.1 Provide a minimum of eight on-site or classroom training sessions, half a day each, throughout the contract period for personnel designated by the City (32 hours total).

.2 Provide two additional training sessions at 6 and 12 months following building’s turnover. Each session shall be half a day in length and must be coordinated with the City.

.3 Train the designated staff of the City’s and the City to prepare them for the following:

.1 Day-to-day Operators:

.1 Proficiently operate the system;

.2 Understand control system architecture and configuration;

.3 Understand DDC system components;

.4 Understand system operation, including DDC system control and optimizing routines (algorithms);

.5 Operate the workstation and peripherals;

.6 Log on and off the system;

.7 Access graphics, point reports, and logs;

.8 Adjust and change system set points, time schedules, and holiday schedules;

.9 Recognize malfunctions of the systems;

.10 Understand system drawings and O&M manual;

.11 Understand the job layout and location of control components;

.12 Access data from DDC controllers and Air System Controllers (ASCs); and,

.13 Operate portable operator's terminals.

.2 Advanced Operators:

.1 Make and change graphics on the workstation;

.2 Create, delete, and modify alarms, including annunciation and routing of these;

.3 Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals;

.4 Create, delete, and modify reports;

.5 Add, remove, and modify system's physical points;

.6 Create, modify, and delete programming;

.7 Add panels when required;

.8 Add operator interface stations;

.9 Create, delete, and modify system displays, both graphical and others;

.10 Perform DDC system field checkout procedures;

.11 Perform DDC controller unit operation and maintenance procedures;

.12 Perform workstation and peripheral operation and maintenance procedures;

.13 Perform DDC system diagnostic procedures;

.14 Configure hardware including PC boards, switches, communication, and I/O points;

.15 Maintain, calibrate, troubleshoot, diagnose, and repair hardware; and,

.16 Adjust, calibrate, and replace system components.

.3 System Managers/Administrators:

.1 Maintain software and prepare backups;

.2 Interface with job-specific, third-party operator software; and,

.3 Add new users and understand password security procedures.

.4 Provide course outline and materials in accordance with Part 1, "Submittals". The instructor(s) shall provide one copy of training material per student.

.5 The instructor(s) shall be factory-trained instructors experienced in presenting this material.

.6 Classroom training shall be done using a network of working controllers, representative of the installed hardware.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 91 00 – General Commissioning Requirements

.2 Section 22 08 00 – Commissioning of Plumbing

.3 Section 23 08 00 – Commissioning of HVAC

.4 Section 23 52 16 – Commissioning of Boiler and Interconnected pressure piping

.5 Section 25 08 00 – Commissioning of Integrated Automation

.6 Section 26 08 00 –Commissioning of Electrical

.7 Section 20 00 00 – Building Automation System

1.2 CONTROL SYSTEM - GENERAL NOTES

.1 Unless otherwise noted, all controls shall be direct digital type (DDC). Actuators shall be electric, unless otherwise noted.

.2 The terms "building automation system" (BAS), "building management system" (BMS), and "building control system (BCS) may be used interchangehably throughout the control diagrams and sequences of operation.

.3 As a minimum, one DDC field control panel (DDCFP) shall be provided for each air handling unit or major piece of equipment or system.

.4 All setpoints indicated in the sequences shall be adjustable at the host computer workstation and via a laptop computer connected to any BCS control panel or controller.

.5 The building control system (all control panels, workstations, host computer, etc.) Shall be connected to standby power.

.6 Software communication shall be required between the BCS and equipment manufacturer's packaged control systems. Provide all integration necessary between the equipment and BCS.

.7 Refer to floor plans for the locations of all space mounted sensors and transmitters. Where not shown, space mounted sensors and transmitters shall be provided.

.8 All common information (outside air temperature, ambient CO^2 level, etc.) Shall be measured and communicated over the BCS network.

.9 An outdoor weather station shall be provided to record ambient air temperature, humidity, and ambient CO^2.

.10 Space CO^2 sensors shall incorporate an ABC (automatic background calibration) algorithm. The algorithm shall only not be applied for 24 hour occupied spaces.

.11 The sequences shall be performed by the DCFP and monitored by the BCS.

.12 Each sequence with a defined occupied period shall have the period adjustable globally (so that all can be the same time frame) and individually (so that any one operation can have a different occupied period).

.13 Factory provided controls shall be used on all equipment whenever available as an equipment OEM option, for integration via a single communication cable.

.14 The controls contractor and mechanical contractor shall coordinate factory provided OEM equipment, sensors and instruments prior to bid.

.15 Incorporate LEED monitoring and reporting requirements in each mechanical system and at building level.

1.3 SEQUENCES OF OPERATION - GENERAL NOTES

.1 Sequences of operations outlined (unless otherwise specified) shall be performed by direct digital control field panels (DDCFP) connected to central building automation system. Address identifiers for all points and variables shown in the diagrams shall be coordinated with the control system and City. Unless otherwise specified, all setpoints and time delays shall be adjustable by the operator through the bas and through menu access at the local terminal / unitary controller without any hardware or software revisions. Monitoring of all functions shall be available at the BAS and at the DDCFP. Provide menu driven capability for the operator to override automated start/stop sequences for each piece of equipment (pumps, air handling units, etc.). If a sequence is disabled by the operator but an automatic start is initiated, the system shall issue an alarm stating that the equipment was unable to start/stop due to user input. The BAS shall then attempt to start the next sequential piece of equipment.

.2 The design intent is for the control system to monitor pressures, temperatures, flow to control valves and, starters and variable frequency drives (VFD). Monitored data will be used to energize or deenergize the equipment.

.3 All equipment controlled by the DDC system shall be capable of manual operation through hand-off-automatic (HOA) switches in starters and VFD provided. The positions of all valves controlled by the building control system shall be capable of manual positioning (open, closed, modulated, auto) via labeled potentiometers, manual switches, or other means to be provided to ensure manual override capability.

.4 The entire building shall have an emergency shutdown sequence shall that is capable of being initiated at the operations center. The emergency shutdown sequence shall confirm the input status for all equipment (providing ventilation) and confirm shutdown of all required fan systems (except those serving emergency system).

.5 Coordinate all sensor installations with the mechanical contractor and submit proposed locations on piping, ductwork and air handling units coordination drawing submittal. Coordinate to ensure that the sensor manufacturer's recommended upstream and downstream diameters are provided (especially flow elements and transmitters).

.6 Provide communications interface and software between the BCS and each equipment manufacturer supplied control panel to read/display all data available at the panel via manufacturer's protocol. Where control is required provide input/output interface indicated.

.7 Fail-safe positions (spring return, battery or capacitor bank…etc.) indicated are positions that devices will go to when deenergized.

.8 Provide adequate damping of all modulating control loops to prevent hunting.

.9 Provide a single global scheduling (occupancy) override of all equipment to place the entire building into the occupied mode to allow for special events.

.10 Whenever a unit is shut down because of one of its safeties, the BCS shall retain in memory the readings and setpoints of each device to help the operator isolate the cause of the shutdown.

.11 Whenever an alarm is initiated, the BCS shall retain in memory the readings and setpoints of each device to assist the operator to isolate the cause of the alarm.

.12 If any local, terminal, unitary controller or equipment manufacturer's control system loses communication with the BCS network, an alarm shall be generated by the BCS indicating the location of the fault.

.13 Each mechanical system inclusive of all equipment and components operating as a single system (e.g AHU and associated VAV, radiant panels, fan coils, cabinet and unit heaters. etc.) shall have a single operator BAS virtual push button for:

.1 Enable / disable

.2 Freeze protection

.3 High ventilation rate (as applicable)

.4 Purge mode (as applicable)

.5 Smoke Exhaust (as applicable)

.14 System shall be provided with local control panels/ operator interface (e.g. push buttons, indication lights, dials…etc) located in room depicted on drawings. Prior to installation re-confirm location with the City stakeholders.

1.4 STATUS - "SYSTEMOK" GENERAL NOTES

.1 Each system shall have a "Systemok" flag to report "True" or "False" to the building control system.

.2 "Systemok" = True

.1 The system is proven "On"

.2 The system is achieving its temperature and/or pressure setpoint(s) for at least 5 minutes.

.3 The system is ready and able to serve its load.

.3 "Systemok" = False

.1 System is in the sequence / process of startup.

.2 Enough of the system's components are unavailable (in alarm, disabled, or turned off) to disrupt the ability of the system to serve its load.

.3 Alarms

.1 Level 1, 2, and some level 3 alarms (as determined by the City) shall inhibit a “Systemok" status.

.2 Level 4 alarms shall not affect "Systemok".

1.5 VARIABLE FREQUENCY DRIVE AND STARTER - GENERAL NOTES

.1 The hand-off-automatic switch on the VFD and/ or starter shall provide for the following basis of control:

.1 Hand position: the DDC system shall have no control over the motor speed nor shall it be able to start or stop the motor (except for safety purposes where the motor shall shut down). The motor shall run under speed control from the hand potentiometer on the VFD. All safeties controlling the shutdown shall be operational (i.e. smoke detectors, pressure switches, motorized dampers limit switches etc. shall be interlocked with the VFD operation permissive). Temperature and humidity control shall be available through the building control system.

.2 The VFD and/ or starter hardwiring and control logic will enable an open air path (e.g. open isolation dampers, mixing dampers…. etc.) prior to enable motor start in Auto or Hand position.

.3 Warning: Due to limited or no BMS control in Hand mode, all system parameters are to be monitored by operator and adjusted accordingly from the Operator Interface.

.4 Off position: the motor shall be off. The buildings control system shall not control the motor. All other control points shall be in their fail-safe position.

.5 Automatic position: the motor shall be controlled by the direct digital control system as described within the sequences of operation

1.6 ALARMS - GENERAL NOTES

.1 There shall be four (4) levels (or classes) of alarm. Levels are described below:

- .1 Level 1 alarms: life-safety message
- .2 Level 2 alarms: critical equipment message
- .3 Level 3 alarms: urgent message
- .4 Level 4 alarms: normal message

.2 Alarms shall include the minimum following information:

- .1 Time & date of alarm
- .2 Level of alarm
- .3 Description of alarm
- .4 Equipment tags for the units in alarm
- .5 Possible causes of the alarm if provided by the fault detection routines
- .6 The source that serves the equipment in alarm

.3 Alarm configuration includes (each alarm):

- .1 Level of alarm
- .2 Latching requirements
- .3 Entry delay
- .4 Exit hysteresis
- .5 Post exit suppression period
- .6 Alarm specific messages

.4 Operators shall have the ability to place equipment in/out of maintenance mode allowing the suppression of alarms.

- .1 Level 1 alarms shall not be suppressed

.5 Entry delays (default entry delays shown below may be modified to better serve the requirement for each specific alarm):

- .1 Level 1 alarms: 1 second
- .2 Level 2 alarms: 10 seconds
- .3 Level 3 alarms: 1 minute
- .4 Level 4 alarms: 5 minutes

.6 Exit hysteresis (default exit hysteresis shown below shall be modified to better serve the requirement(s) for each specific alarm):

- .1 Time: 5 seconds
- .2 % of limit: 0%

.7 Latching (default settings may be modified to better serve the requirement for each specific alarm):

- .1 Level 1 alarms: latching
- .2 Level 2 alarms: latching
- .3 Level 3 alarms: non-latching

.4 Level 4 alarms: non-latching

.8 Post exit suppression period (default periods shown below may be modified to better serve the requirement(s) for each specific alarm):

.1 Level 1 alarms: 0 minutes

.2 Level 2 alarms: 5 minutes

.3 Level 3 alarms: 24 hours

.4 Level 4 alarms: 7 days

.9 The controls contractor shall tune alarm requirements specifically for each application as required for optimal operations for each process, and device.

1.7 STATIC PRESSURE RESET - GENERAL NOTES

.1 Trim and respond:

.1 Trim and respond (T&R) static pressure reset logic shall reset (reduce) the differential static pressure setpoint at fixed rate and set intervals until downstream zone(s) are no longer satisfied and generates enough request(s) for an increased setpoint. Once increased and the downstream zone(s) are no longer sending enough "Requests", the setpoint shall resume the trim operation until the sequence is repeated.

.2 Trim and respond valves to be programmed within the reset logic shall include but are not limited to: (defaults shown are for fan systems, modify defaults as required for both implementation of fan systems and hydronic systems):

.1 SP_o - Initial setpoint (Default = 0.5)

.2 SP_{min} - Minimum setpoint (Default = 0.15)

.3 SP_{max} - Maximum setpoint (Default = System design setpoint)

.4 T_d - Delay timer (Default = 5 minutes)

.5 T - Time step (Default = 2 minutes)

.6 I - Number of ignored requests (Default = 2 requests)

.7 R - Number of requests from zones / systems

.8 SP_{trim} - Trim amount (Default = -0.04")

.9 SP_{res} - Respond amount (Must be opposite in sign to SP_{trim}) (Default = +0.06")

.10 $SP_{res-max}$ - Maximum response per time interval (Must be same as SP_{res}) (Default = +0.15")

.3 Each downstream zone shall have the following characteristics:

.1 Importance multiplier (Default = 1)

.1 Used to scale the number of requests.

.2 System shall be tuned to identify "Rogue Zones" that prevent proper T&R operation.

.2 Request-hours

.1 Every x minutes (Default = 5 minutes), add x/60 times the current number of requests to this request hours accumulator point. The request-hours accumulator point is reset to zero upon a global command from the system/plat serving the zone/system - this global point simultaneously resets the request-hours point for all zones/system served by this system / plant.

.3 Cumulative%-request-hours

.1 Zone/system request hours divided by the zone/system run hours, expressed as a percentage. Unoccupied hours shall not be recorded.

.4 Logic

.1 The static pressure shall be reset between the minimum (SP_{min}) and the design static pressure (SP_{max}).

.2 When the fan / pump is off, the setpoint shall be froze to the initial static pressure setpoint allowed (SP_o).

.3 When the system is enabled, the T&R logic shall include a delay (td) to allow for initial equipment startup.

.4 When active, the static pressure shall be reduced by the setpoint trim valve (SP_{trim}) every time step (t).

.5 If there are more than the number of setpoint ignore (i) request; respond by changing the setpoint by the number of requests minus the number of ignore requests (SP_{res} x (r-i)). The static pressure setpoint shall not be increased beyond the maximum allowable setpoint (SP_{max}).

.5 Alarms

.1 If the zone importance factor is greater than zero, the zone/system cumulative%-request-hours exceeds 70%, and the total number of zone/systems run-hours exceeds 40; generate a level 4 alarm at the bas & graphic user interface.

.6 Tuning: each zone and system utilizing T&R logic shall be tuned specifically for that application. The values suggested are a starting point and will likely require adjustment during the commissioning/tuning phase.

.2 Critical zone:

.1 Critical zone static pressure reset logic shall reset the differential static pressure setpoint based on the critical damper or valve position. This critical damper / valve position shall be the input into the PID control loop. Using the PID control logic, the most critical damper / valve shall be adjusted by resetting the differential static pressure to maintain a setpoint of 90% open.

.2 When the fan / pump is off, the PID loop shall be disabled to prevent wind-up and freeze the output at zero.

.3 The static pressure shall be reset between the range of 0.15 inches (0% PID output) and the design static pressure (100% PID output).

1.8 ZONE GROUPS

.1 Each system shall be broken into separate zone groups composed of a collection of one or more zones served by a single air handling unit.

.2 Each zone group shall be capable of having separate occupancy schedules and operating modes from other zone groups.

.3 All zones in each zone group shall be in the same zone-group operating mode. If one zone is placed in any zone-group operating mode other than unoccupied (due to override, sequence logic, or scheduled occupancy), all zones in that zone group shall enter that mode.

.4 A zone group may be in only one mode at a given time.

.5 Provide a set of testing / commissioning software switches that override all zones served by the zone group.

.1 Each terminal unit within the zone group shall have separate dedicated overrides.

1.9 ZONE GROUP OPERATING MODES

.1 Occupied mode:

.1 The mode occurs when the following is true:

.2 The time of day is between the zone group's scheduled occupied start and stop times.

.3 The schedules have been overridden by the occupant override system.

.4 Any zone local override time (initiated by local override button) is nonzero.

.2 Unoccupied mode:

.1 Off:

.1 The mode occurs when the zone group is not in any other mode.

.2 Warm-up mode:

.1 For each zone the bas shall calculate the required warm-up time to reach the occupied heating setpoint at the scheduled occupancy time. An "optimal start" algorithm shall use the following to calculate the time for each zone warm-up:

.1 The current zone temperature

.2 The occupied heating setpoint

.3 The outdoor air temperature

.4 The zone's mass/capacity factor

.2 The mass/capacity factor shall be manually adjusted for each zone or self-adjusting by the BMS.

.1 If the mass/capacity factor is self-adjusting thru the bas, the self-tuning process shall be turned off (stopped) once the system has self-tuned and has been trained.

.3 Warm-up mode shall start based on the zone with the longest calculated warm-up time requirement, but no earlier than 3 hours prior to the scheduled occupancy period.

.4 Warm-up mode shall end at the scheduled occupied start time.

.5 Zones where the window switch indicates that the window is open shall be ignored.

.3 Cooldown mode:

.1 For each zone the bas shall calculate the required cool-down time to reach the occupied cooling setpoint at the scheduled occupancy time. An "optimal start" algorithm shall use the following to calculate the time for each zone cool-down:

.1 The current zone temperature

.2 The occupied cooling setpoint

.3 The outdoor air temperature

.4 The zone's mass/capacity factor

.2 The mass/capacity factor shall be manually adjusted for each zone or self-adjusting by the bas.

.1 If the mass/capacity factor is self-adjusting thru the bas, the self-tuning process shall be turned off (stopped) once the system has self-tuned and has been trained.

.3 Cool-down mode shall start based on the zone with the longest calculated cool-down time requirement, but no earlier than 3 hours prior to the scheduled occupancy period.

.4 Cool-down mode shall end at the scheduled occupied start time.

.5 Zones where the window switch indicates that the window is open shall be ignored.

.4 Setback mode:

.1 During the unoccupied mode, if any 5 zones (or all zones if there are fewer than 5) in the zone group fall below their unoccupied heating setpoints, or if the average zone temperature of the zone group falls below the average unoccupied heating setpoint; the zone group shall enter setback mode until all spaces in the zone group are 2°f above their unoccupied setpoints.

.5 Freeze protection mode:

.1 During the unoccupied mode, if any single zone falls below 40°F; the zone group shall enter setback mode until all zones are above 45°F, and a level 3 alarm shall be set.

.6 Setup mode:

.1 During the unoccupied mode, if any 5 zones (or all zones if there are fewer than 5) in the zone group rise above their unoccupied cooling setpoints, or if the average zone temperature of the zone group rises above the average unoccupied cooling setpoint; the zone group shall enter setup mode until all spaces in the zone group are 2°F below their unoccupied setpoints.

.2 Zones where the window switch indicates that the window is open shall be ignored

1.10 AVERAGE VALUE

.1 Large open space shall have multiple averaging sensors. One sensor is not acceptable.

.2 Where multiple sensors are provided for same area or function (e.g. temperature sensors) the average value of all sensors shall be used. If either sensor fails, the remaining operational sensors will assume control and average function, and a Level 3 alarm will be generated.

1.11 ENERGY RECOVERY VENTILATOR ERV-01

.1 General

.1 Unit shall operate as a variable volume air handling unit.

.2 Controls described herein shall be performed by DDC controller using electric actuation and either PI or PID control logic. PI or PID control shall be determined by the applications ability for control tuning. Provide all interface, wiring, relays, interlocks, controls, and programming as required for operation.

.3 Unit shall generally consist, but not limited to, the following:

.1 Supply fan(s) and Return fan(s) with VFD speed control(s).

.2 Chilled water coil(s).

.3 Heating water coil(s).

.4 Filter sections.

.5 Motorized isolation dampers.

.6 Air flow stations.

.7 Humidifier section (external in ductwork).

.8 Economizer

.9 Variable speed energy recovery wheel.

.10 Electric preheater.

.4 The air handling unit shall have, as a minimum, the following hardwired connections:

.1 BACNET MS/TP or BACNET IP network interface for monitoring unit operation and performance.

.2 Fire alarm and/or fire protection and/or suppression system.

.3 Safety related items, e.g. high/ low temp, pressure, humidity switches, etc.

.2 Building management system (BMS) interface

.1 The DDC field control panel shall communicate virtual points to the BMS.

.2 ALL virtual points shall be mapped to the BMS and shall be readable and/or writeable through the BACNET communications link.

.1 If communication is lost with the BMS, the unit controller shall operate using its last communicated setpoints and run command and an alarm shall be generated.

.3 Scheduling

.1 ERV shall be able to operate continuously (24 hours per day) and or by Operator selectable Schedule.

.2 The unit shall be programmed to be capable of operating in two occupancy modes and various sub-operating modes that shall be made available 24/7 for operation. Refer to the "Zone Groups" and "Zone Groups Operating Modes" descriptions section for operating modes to be made available to the unit. The occupancy modes are as follows:

.1 Occupied mode:

.1 Startup / shutdown

.2 Fan control

.3 Cooling / heating mode

.4 Humidification/ Dehumidification

.5 Economizer

.2 Unoccupied mode

.1 Off

.2 Freeze protection

.4 Startup

.1 Upon a signal from the BMS to start the unit, perform the following:

.1 Isolation damper shall be verified open.

.2 Once the damper has been verified open, enable the supply air fan(s) and the return air fan(s). Modulate fan speed based on air flow requirements.

.3 Once the fan(s) have been verified on, energize /modulate energy recovery wheel.

.4 Modulate open either the chilled water control valve or modulate the glycol heating water control valve to maintain sequence of operation setpoints.

.5 Modulate the electrical pre heat coil to prevent heat recovery wheel freeze. Freeze protection setpoints shall be provided by the manufacturer.

.6 Measure calculate outdoor and exhaust air enthalpy and enable economize mode, as applicable.

.5 Shutdown

.1 Upon a signal from the BMS to shut down the unit, perform the following:

.1 Disable the return air fan(s) and supply air fan(s).

.2 Close the Isolation dampers.

.3 Disable preheat and humidifier.

.4 While closing the dampers, continue modulating either the chilled water or heating water valves to maintain sequence of operation setpoints.

.5 Once the dampers have been verified as being closed/open, the heating water and chilled water control valves shall be modulated closed.

.6 Fan control

.1 Supply fan(s)

.1 The supply fan(s) shall modulate to maintain duct static pressure setpoint.

.2 Initial setpoint shall be 0.7" (adjustable) at the supply air duct static pressure sensor. Sensors are in the ductwork approximately 2/3 down the main supply air duct (exact location to be coordinated on site during construction. The setpoint shall be adjusted and optimized during testing and balancing.

.3 On a fall in duct static pressure as sensed by the supply air duct static pressure sensor; increase the supply fan speed.

.4 On a rise in static pressure as sensed by the supply air duct static pressure sensor; decrease the supply fan speed.

.2 Return fan(s)

.1 The return fan(s) shall modulate to maintain building exhaust airflow, and to maintain the washroom/ locker room at negative pressure at all times.

.2 Note: during occupied mode the exhaust air flow is constant.

.3 During the normal operation of the unit the supply air fan(s) shall be controlled to modulate at 100 cfm less (adjustable) than that of the total exhaust fan(s) airflow rate to ensure the space is always maintained at negative pressure.

.3 The fans modulate from minimum low flow setpoint xxx cfm to maximum unit flow.

.1 Minimum air flow is determined by the manufacturer.

.4 The contractor shall record the airflow difference and the building static pressure.

.5 The airflow differential shall be adjusted to maintain a building static pressure of -0.05" at all operating conditions.

.7 Cooling mode

.1 The unit shall be indexed into the cooling mode when the temperature sensed at outdoor air temperature sensor is 55°F (adjustable) or greater. The controls contractor shall make necessary setpoint adjustments to tune the cooling mode / heating / heat recovery mode switchover in the field.

.2 When indexed into the cooling mode, modulate the chilled water cooling coil control valve to maintain 55°F discharge air temperature as sensed by the supply air discharge temperature sensor.

.8 Heating mode

.1 The air handling unit shall be indexed into the heating mode when the temperature sensed at the mixed air temperature sensor is 54°F (adjustable) or less. The controls contractor shall make necessary setpoint adjustments to tune the cooling / heating / heat recovery mode switchovers in the field.

.2 When indexed into the heating mode, modulate the hot water heating coil control valve to maintain 65°F discharge air temperature (adjustable) as sensed by the supply air discharge temperature sensor.

.3 If the unit is started when the outdoor temperature is less than 54°F (adjustable), the preheat coil and hydronic coil is enabled to modulate and the discharge temperature ramps down gradually to its set point value to prevent the heating safety from undershooting and tripping the low temperature cut-off (time delayed).

.4 Note: AHU hydronic section freeze prevention:

.1 If the AHU is not operating and/or in fault mode and the outdoor temperature is lower than 10C (adjustable) the heating valve shall modulate to maintain AHU cabinet temperature at 10C as sensed by the air temperature and heating coil discharge temperature.

.9 Energy Recovery wheel

.1 Factory provided rotation sensor that will monitor the energy wheel rotation. A digital signal will be provided if the wheel does not rotate for 30 seconds.

.2 Wheel speed shall be optimized for maximum energy recovery in all operation conditions by the manufacturer.

.10 Frost control:

.1 Frost Control for the energy wheel is enabled when frost is present on the wheel; based on the outside air temperature and the pressure drop across the wheel. If the outdoor air temperature is below 5°F (adjustable) and the differential pressure across the wheel is above 1.5" (adjustable and/ or as per manufacturer recommendations) frost control will enable.

.2 When frosting has occurred, the VFD modulates the wheel down to a slow rotational speed to defrost the wheel. Once either the pressure drop decreases below the pressure switch set point, or the outdoor air temperature increases above the temperature set point, the unit will resume normal operation.

.11 Humidity control

.1 The external humidifier shall be modulated as required to maintain the desired space humidity set point as sensed by a sensor located in the return air plenum. The relative humidity set point is automatically and proportionally reset by the outdoor air temperature according to the following schedule:

Outdoor Air Temperature	R/A Humidity Set point
-20° C	20% RH
+10° C	30% RH

Note: if windows condensation becomes a concern, adjust humidity setpoint accordingly.

.2 The operation of the humidifier shall be overridden if the supply air humidity approaches 60% RH. In addition, an alarm shall be initiated if the supply air humidity exceeds 60% RH.

.3 The unit shall modulate the cooling coil accordingly to maintain space humidity within setpoint range, during summer cooling season without overcooling the space.

.4 Humidity controls and safeties such as air proving switch/ and /or air flow station and high limit humidity shall disable humidifier operation.

.12 Unoccupied "Off" mode

.1 The air handling unit shall be off during this mode. Supply and return fans de-energized, all dampers shall be in their failsafe positions.

.13 Unoccupied "Freeze Protection" mode

.1 During the unoccupied mode, if any single zone falls below 40°F (adjustable); the air handling unit shall be enabled and energized until all zones are above 45°F, and alarm shall be set.

.2 If the air handling unit is turned off, the isolation dampers close, and if the outdoor temperature is low enough, adjustable setpoint 50°F, the glycol heating valves are modulated to maintain an air handling unit cabinet temperature of 45°F, adjustable.

.14 Alarms

.1 Airflow alarm

.1 An airflow stations are provided on supply, return/ exhaust and outdoor air

.2 Level 2 Alarm: Upon a signal to the air fan to be enabled, if the airflow is not proven within 15 seconds (provide delay for damper opening and startup procedures);

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The chilled water and heating water valves shall return to their fail-safe positions

.4 Alarm shall be provided.

.3 Level 3 alarm: upon a signal to the fan to be disabled, if no airflow after 2 minutes, generate a level 3 alarm

.4 Disable/ inhibit humidifier operation (prevent water/ condensation)

.2 Damper position alarms

.1 All dampers shall be provided with position indication.

.2 Level 2 alarm: upon a signal to open the isolation damper, if the position switch does not activate within the installed damper actuator motor drive run time + 10 seconds; generate an alarm.

.3 Filter status alarm

.1 A differential pressure sensor shall monitor the differential pressure across the filters(s).

.2 The maximum filter differential pressure setpoint shall be verified and coordinated with the capabilities of the filter style and filter manufacturer.

.3 Level 4 alarm If the filter differential pressure is greater allowable differential pressure; generate an alarm at the bas & graphic user interface.

.4 Level 3 alarm: if the filter differential pressure is greater than 110% of the calculated allowable differential pressure; generate a level 3 alarm at the bas & graphic user interface.

.4 Freezestat alarm

.1 Level 2 alarm: A freezestat shall be mounted downstream of the hot water heating coil and in humidifier section.

.2 The freezestat shall use an averaging low temperature detection sensor / switch and be reset manually (reset shall be located at accessible location).

.3 Alarm: upon activation of the freezestat (setpoint shall be 38°f);

.1 Deenergize the fan(s) and / or the humidifier, shutoff water supply and enable humidifier drain cycle.

.2 Dampers shall return to their fail-safe positions

.3 The chilled water and heating water valves shall return to their fail-safe positions

.4 Alarm shall be provided.

.4 Level 2 alarm: Low temperature in humidifier section

.1 Alarm: setpoint shall be 38°F:

.1 Deenergize the humidifier

.2 Enable humidifier drainage sequence

.3 Alarm shall be provided

.5 Fire Alarm and Duct smoke detector alarm

.1 Fire alarm indication shall be provided

.2 Duct smoke detectors shall be placed in the air stream, as applicable

.3 Level 1 alarm: upon activation of the smoke detector or fire alarm signal;

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The chilled water and heating water valves shall return to their fail-safe positions

.4 A signal shall also be sent to the fire alarm control panel

.5 Alarm shall be provided.

.6 Supply air temperature alarm

.1 Software logic shall monitor the discharge supply temperature from the unit.

.2 Level 3 alarm: at the supply air temperature sensor, if the discharge air temperature rises/drops above or below the setpoint temperature by 5 degrees or more for a duration of 15 minutes or more, an alarm shall be generated

.7 Supply air humidity alarm

.1 Software logic shall monitor the discharge supply humidity / dewpoint from the unit.

.2 Level 3 alarm: at the supply air humidity sensor, if the discharge air humidity rises above 66°F dew point for a duration of 15 minutes or more, an alarm shall be generated.

.8 Variable frequency drive fault alarm

.1 Faults generated by an associated variable frequency drive; the unit shall de-energize associated fan(s).

.2 Level 2 alarm: upon report of a fault

.1 Deenergize the associated fan(s).

.2 For multiple supply, multiple return/exhaust fan unit only: The unit shall remain in operation with the remaining fan(s) that are operable.

.3 Alarm shall be provided.

.15 Loss of power

.1 Upon loss of power; all dampers, valves, etc. Shall return to their fail-safe positions.

.2 The air handling unit controller shall retain all information regarding the setpoints and status of operation at the time of power failure.

.3 Upon restoration of power; the air handling unit shall have a delay of 60 seconds prior to restart.

.1 All air handling units shall provide a staggered start operation to minimize electrical demand surge during restart.

.16 Testing/commissioning overrides

.1 Provide software switches that interlock to a chilled water and hot-water plant system level point to perform the following:

.1 Force HW valve full open.

.2 Force HW valve full closed.

.3 Force chilled water valve full open.

.4 Force chilled water valve full closed.

.5 Plant Chilled water supply request.

.6 Plant Hot water supply request.

.17 Requests / resets

.1 Chilled water system pressure reset

.1 Terminal unit shall send all required requests made for trim & respond logic chilled water system pressure reset control.

.1 If the CHW valve position > 95%, send 1 request until the CHW valve position is less than 10%. Else, if the CHW valve position < 10%, send 0 requests.

.2 Terminal unit shall send all required position feedback for critical zone PID control logic chilled water system pressure reset control.

.2 Heating hot water system pressure reset

.1 Terminal unit shall send all required requests made for trim & respond logic heating hot-water system pressure reset control.

.1 If the HW valve position > 95%, send 1 request until the HW valve position is less than 10%.

.2 Else, if the HW valve position < 10%, send 0 requests.

.2 Terminal unit shall send all required position feedback for critical zone PID.

.18 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.12 HEAT RECOVERY UNIT HRU-XX

.1 General

.1 Unit shall operate as a variable volume air handling unit.

.2 Controls described herein shall be performed by DDC controller using electric actuation and either PI or PID control logic. PI or PID control shall be determined by the applications ability for control tuning. Provide all interface, wiring, relays, interlocks, controls, and programming as required for operation.

.3 Unit shall generally consist, but not limited to, the following:

.1 Supply fan(s) and Return fan(s) with VFD speed control(s) and backdraft dampers.

.2 Heating water coil(s).

.3 Cooling coil(s), as applicable.

.4 Frost protection heating coils, as applicable.

.5 Filter sections.

.6 Motorized Outside, Exhaust, internal VAV air dampers.

.7 Motorized isolation air dampers.

.8 Air flow stations.

.9 Double plate heat exchanger heat recovery section.

.4 The unit shall have, as a minimum, the following hardwired connections:

.1 BACNET MS/TP or BACNET IP network interface for monitoring unit operation and performance.

.2 Fire alarm and/or fire protection and/or suppression system.

.3 Safety related items, e.g. high/low temp, pressure, humidity switches…. etc.

.2 Building management system (BMS) interface

.1 The DDC field control panel shall communicate virtual points to the BMS.

.2 ALL virtual points shall be mapped to the BMS and shall be readable and/or writeable through the BACNET communications link.

.1 If communication is lost with the BMS, the unit controller shall operate using its last communicated setpoints and run command and an alarm shall be generated.

.3 Scheduling

.1 Units hall be able to operate continuously (24 hours per day) and or by Operator selectable Schedule.

.2 The unit shall be programmed to be capable of operating in two occupancy modes and various sub-operating modes that shall be made available 24/7 for operation. Refer to the "Zone Groups" and "Zone Groups Operating Modes" descriptions section for operating modes to be made available to the unit. The occupancy modes are as follows:

.1 Occupied mode:

.1 Startup / shutdown

.2 Fan control

.3 Ventilation

.4 Cooling, as applicable

.5 Heating mode

.6 Gas Detection

.2 Unoccupied mode

.1 Off

.2 Freeze protection

.3 Gas Detection

.4 Startup

.1 Upon a signal from the BMS to start the unit, perform the following:

.1 Isolation damper shall be verified open.

.2 Once the damper has been verified open, enable the return air fan(s) and the supply air fan(s).

.3 Once the fan(s) have been verified on, modulate the VAV dampers based on manufacturer recommendations.

.4 Once the fan(s) have been verified on, energize energy recovery double heat exchanger dampers.

.5 Modulate open either the chilled water control valve or modulate the heating water control valve to maintain sequence of operation setpoints.

.5 Shutdown

.1 Upon a signal from the BMS to shut down the unit, perform the following:

.1 Disable the return air fan(s) and supply air fan(s) and double heat exchanger dampers.

.2 While closing the dampers, continue modulating either the chilled water or heating water valves to maintain sequence of operation setpoints.

.3 Once the dampers have been verified as being closed/open, the heating water and chilled water control valves shall be modulated closed.

.6 Fan control

.1 Return fan(s)

.1 The return fan(s) shall modulate to maintain air flow requirements.

.1 Initial setpoint shall be xxx cfm at the return air flow sensor. The setpoint shall be adjusted and optimized during testing and balancing.

.2 Modulate the supply fan speed from minimum to maximum, as required by heating, cooling, ventilation and or gas detection system.

.2 Supply fan(s)

.1 The supply fan(s) shall modulate to maintain building supply airflow / return airflow differential flow rates, and to maintain the space at negative pressure always.

.2 During the normal operation of the unit the supply air fan(s) shall be controlled to modulate at 500 cfm less (adjustable) than that of the total return fan(s) airflow rate to ensure the space is always maintained at negative pressure.

.3 The fans modulate from minimum low flow setpoint xxx cfm to maximum unit flow.

.4 Fan Redundancy: if an exhaust or supply fan is commanded to be on but is sensed as being off (i.e. no flow and/or VFD current sensed), the BMS shuts down the fan that is off and an alarm is generated to alert the operator of the need for service, AND, if an exhaust or supply fan fails to run (the fan shuts down) the BMS will modulate up its pair trying to maintain max air flow with the remaining fan/s and will modulate down its counterpart fans to ensure negative pressure is maintained in the building at all times, if the speed is required to be modulated down below 25% (or as per manufacturer recommendations) one of the counterpart fans, the counterpart fan shall be commanded to stop running. Note: under a fan failure condition, the HOA switches should be left in the ‘Auto’ position to ensure that the proper pressure regime (slight negative) is maintained in the building, system will continue running with one pair of fans. If maintenance is to be performed on the unit, the unit shall be shutdown. Disconnect and lockout power to unit accordingly.

.7 Heating mode

.1 The air handling unit shall be indexed into the heating mode when the temperature sensed at the outdoor air temperature sensor is 60°F (adjustable based on each space heating requirements) or less. The controls contractor shall make necessary setpoint adjustments to tune the cooling mode / heating / double heat exchanger dampers energy recovery.

.2 If the unit is started when the outdoor temperature is less than 54°F (adjustable), the hydronic coil is enabled to modulate, and the discharge temperature ramps down gradually to its set point value to prevent the heating safety from undershooting and tripping the low temperature cut-off (time delayed).

.1 If the unit is started when the outdoor temperature is less than 34°F (adjustable), and the pressure differential on the heat exchanger plates exceeds the normal range, and if there is no gas detection alarm, the unit may engage recirculation defrost mode for a few minutes, as recommended by the manufacturer, prior to enabling heat recovery mode.

.3 Variable temperature, variable flow. Units shall start operating at low speed, unless in gas detection mode, as required to meet the building thermal demand. The discharge air temperature will initially be 18F (adjustable) above the space temperature set point. If the space temperature drops 4F below the space heating temperature, or the heating demand is not satisfied within 10 minutes, shall be the discharge air temperature shall be increased to a maximum of 25F (adjustable) above the space heating set point, or maximum discharge temperature of 100F (adjustable), until the heating demand is satisfied. If space temperature is not satisfied, the fan speed shall be increased gradually up to 100%. This heating scenario shall be optimized by BAS trending and algorithm set points adjustments to minimize energy consumption. The reverse sequence shall occur if less heat demand is requested.

.4 Note: the heating coils are oversized and able to heat the air from outdoor design day to +10°F, however this scenario will only be entertained during an emergency and malfunction of the double heat exchanger dampers. Normal operation discharge temperature shall be as per clause #3 above.

.8 Double Heat Exchanger Energy Recovery

.1 Factory provided double heat exchanger actuator.

.2 Based on air flow and air velocity over the heat recovery heat exchangers modulate the VAV dampers based on manufacturer recommendations.

.3 Actuator switchover shall be optimized for maximum energy recovery and automatic changeover (cooling, heating, ventilation, frost protection) in all operation conditions.

.4 Switchover shall be optimized to prevent frost formation. Once exhaust air temperature increases above the temperature set point, the unit will resume normal operation.

.1 If the unit is equipped with exhaust preheat coil defrost protection, modulate open the control valve to energize defrost mode.

.9 Ventilation (and Free Cooling) Mode

.1 The air handling unit shall be indexed into the ventilation/ free cooling mode when not in heating mode. The controls contractor shall make necessary setpoint adjustments to tune the ventilation mode / heating / heatpipe energy recovery switchover in the field.

.2 Units shall operate at low speed as required to meet the building thermal demand.

.3 If space temperature is not satisfied, namely the average space temperature if raising above the outdoor temperature fan speed shall be increased gradually up to 100%. This ventilation scenario shall be optimized by BAS trending and algorithm set points adjustments to minimize energy consumption. The reverse sequence shall occur if less ventilation/ free cooling demand is requested.

.10 Cooling mode (for units equipped with cooling coils)

.1 The air handling unit shall be indexed into the cooling mode at the outdoor air temperature sensor is 76°F (adjustable based on each space heating requirements) or greater. The controls contractor shall make necessary setpoint adjustments to tune the cooling mode / heating / economizer mode switchover in the field.

.2 When indexed into the cooling mode, modulate the chilled water-cooling coil control valve to maintain 55°F (adjustable dependent on space requirements) discharge air temperature as sensed by the supply air discharge temperature sensor.

.11 Minimal Dehumidification mode (for units equipped with cooling coils)

.1 Although the units is not equipped with a full dehumidification system, some dehumidification relief shall be enabled only if unit is enabled in “cooling mode”.

.2 The unit shall be indexed into the dehumidification mode when the humidity sensed at return air humidity sensor exceeds the allowable humidity, initially set at 50% (adjustable).

.3 The controls contractor shall make necessary setpoint adjustments to tune the cooling / heating / dehumidification mode switchovers in the field.

.4 When indexed into the dehumidification mode, modulate the cooling coil to maintain the supply air within the allowable humidity range without overcooling the space.

.12 Gas Detection:

.1 Carbon monoxide (CO), nitrous dioxide (NO2), Gasoline/ VOC sensors levels are monitored throughout the space via local mounted sensors.

.2 The CO/ NO2/ Gasoline/ VOC levels from each sensor are fed to the Gas Detection System which interfaces with the unit and BAS and Building Security System. The BAS will notify the Building Operators for their response according to all facility Safety Operating Procedures.

.3 Provide simultaneous audio and visual alarms throughout the space to warm the occupants in the event of CO/ NO2/ Gasoline/ VOC gas detection.

.4 High air flow shall be enabled on detection of CO/ NO2/ Gasoline/ VOC concentration rising above the low limits.

.5 If CO/ NO2/ Gasoline/ VOC gas concentrations rise to the low limits in the space, the ventilation system shall initiate the following:

.1 If the ventilation system is in OFF Mode, energize both supply fans and exhaust fans at low speed (minimum 35% air flow - adjustable),

.2 The ventilation system shall run in until the gas concentration is lowered 0.5 ppm below the lower limit and continue to operate for 5 minutes.

.3 If CO/ NO2/ Gasoline/ VOC concentrations are not declining or rises to high limits in the space, the ventilation system shall continue to operate and increase to high speed up to maximum 100% air flow. The ventilation system shall run in high speed until the gas concentration is lowered 0.5 ppm below the lower limit and continue to operate for 10 minutes (adjustable).

.6 Activate audio and visual alarms throughout in the corresponding area. The audible alarm shall be recognizable and may be stopped by the authorized personnel, whereas the visual device shall stay in operation if the detection system is in alarm.

.1 Low Limits:

.1 CO = 15 ppm

.2 NO_2 = 1 ppm

.3 Gasoline/ VOC =10% LEL

.2 High Limits:

.1 CO => 25 ppm

.2 NO_2 => 2 ppm

.3 Gasoline/ VOC =>20% LEL

.3 System Alarm Limits:

.1 CO => 100 ppm

.2 NO_2 => 3 ppm

.3 Gasoline/ VOC =>25% LEL

.7 Refer to clause O-(d)-2 below for additional requirements.

.13 Unoccupied "Off" mode

.1 The air handling unit shall be off during this mode. Supply and return fans de-energized, all dampers shall be in their failsafe positions.

.14 Unoccupied "Freeze Protection" mode

.1 During the unoccupied mode, if any single zone falls below 40°F (adjustable); the unit heaters in the space should be energized and/ or the air handling unit shall be enabled and energized until all zones are above 45°F, and alarm shall be set.

.2 If the air handling unit is turned off, the isolation dampers close, and if the outdoor temperature is low enough, adjustable setpoint 50°F, the glycol heating valves are modulated to maintain an air handling unit cabinet temperature of 45°F, adjustable.

.15 Alarms

.1 Airflow alarm

.1 An airflow stations are provided on supply, return and exhaust air

.2 Level 2 Alarm: Upon a signal to the air fan to be enabled, if the airflow is not proven within 15 seconds (provide delay for damper opening and startup procedures);

.3 Deenergize the fan(s)

.4 Dampers shall return to their fail-safe positions

.5 The chilled water and heating water valves shall return to their fail-safe positions

.6 Alarm shall be provided.

.7 Level 3 alarm: upon a signal to the fan to be disabled, if no airflow after 2 minutes, generate a level 3 alarm

.8 Disable/ inhibit humidifier operation (prevent water/ condensation)

.2 Damper position alarms

.1 All dampers shall be provided with position indication.

.2 Level 2 alarm: upon a signal to open the isolation damper, if the position switch does not activate within the installed damper actuator motor drive run time + 10 seconds; generate an alarm.

.3 Filter status alarm:

.1 A differential pressure sensor shall monitor the differential pressure across the filters(s).

.2 The maximum filter differential pressure setpoint shall be verified and coordinated with the capabilities of the filter style and filter manufacturer.

.3 Level 4 alarm: If the filter differential pressure is greater allowable differential pressure; generate an alarm at the bas & graphic user interface.

.4 Level 3 alarm: if the filter differential pressure is greater than 110% of the calculated allowable differential pressure; generate a level 3 alarm at the bas & graphic user interface.

.4 Freezestat alarm

.1 Level 2 alarm: A freezestat shall be mounted downstream of the hot water heating coil

.2 The freezestat shall use an averaging low temperature detection sensor / switch and be reset manually (reset shall be located at accessible location).

.3 Alarm: upon activation of the freezestat (setpoint shall be 38°f);

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The chilled water and heating water valves shall return to their fail-safe positions

.4 Alarm shall be provided.

.4 Level 2 alarm: Low temperature in humidifier section

.1 Alarm: setpoint shall be 38°F:

.1 Deenergize the humidifier

.2 Enable humidifier drainage sequence

.3 Alarm shall be provided

.5 Fire Alarm and Duct smoke detector alarm

.1 Fire alarm indication shall be provided

.2 Duct smoke detectors shall be placed in the air stream, as applicable.

.3 Level 1 alarm: upon activation of the smoke detector or fire alarm signal;

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The chilled water and heating water valves shall return to their fail-safe positions

.4 A signal shall also be sent to the fire alarm control panel

.5 Alarm shall be provided.

.6 Supply air temperature alarm

.1 Software logic shall monitor the discharge supply temperature from the unit.

.2 Level 3 alarm: at the supply air temperature sensor, if the discharge air temperature rises/drops above or below the setpoint temperature by 5 degrees or more for a duration of 15 minutes or more, an alarm shall be generated

.7 Variable frequency drive fault alarm

.1 Faults generated by an associated variable frequency drive; the unit shall de-energize associated fan(s).

.2 Level 2 alarm: upon report of a fault

.1 Deenergize the associated fan(s).

.2 For multiple supply, multiple return/exhaust fan unit only: The unit shall remain in operation with the remaining fan(s) that are operable.

.3 Alarm shall be provided.

.8 Return air VOC alarm

.1 Refer to LEED requirements and conduct building air flushing before or during occupancy.

.2 Refer to LEED requirements and conduct air testing, as applicable.

.3 Post occupancy, trend VOC levels for 30 (adjustable) days to establish the initial VOC baseline.

.4 VOC shall be trended and compared on weekly basis. Building operator shall compare the VOC trends with the building occupancy activities, e.g. painting activities, carpets replacement, new hardware, or furniture .... etc.

.5 Level 3 alarm: at the return air VOC sensor, if the return air VOC trend is rising above the VOC baseline for more than 30% (adjustable) for a duration of 30 minutes or more (adjustable), an alarm shall be generated, and

.1 Increase outdoor air fraction of the system up to maximum system setpoint to provide building enhanced air flushing.

.2 If VOC trend is not falling after a duration of two hours or more (adjustable)

.1 Further action, such as local investigation of the source of VOC and removal from the facility shall be taken.

.3 Reserve outdoor air fraction to normal operation upon the return air VOC trend descending towards baseline.

.6 Level 2 alarm: at the return air VOC sensor, if the return air VOC trend is rising above the VOC baseline for more than 50% (adjustable) for a duration of 30 minutes or more (adjustable) , an alarm shall be generated, and

.1 Further action, such as local investigation of the source of VOC and removal from the facility or any other actions shall be taken by the operator according to all facility Safety and Operating Procedures.

.9 CO/ NO2/ Gasoline alarm:

.1 Level 1 alarm: High Limit

.2 Level 2 alarm: Low limit

.3 NOTE: Further actions, e.g. evacuate the facility, shall be taken by the operator according to all facility Safety and Operating Procedures.

.16 Fueling systems interlock:

.1 When the supply fans and exhaust fan status have been proved ON for more than 30 seconds, the fuel interlocks shall be commanded ON and shall remain ON until either supply fan status point and /or exhaust fans status is OFF.

.2 If the ventilation system fails an audible and visual alarm shall alarm the personnel. The audible alarm shall be recognizable and may be stopped by the authorized personnel, whereas the visual device shall stay in operation as long as the ventilation system is in fault.

.3 The fueling operation shall be discontinued (hardwire interlock) when the fueling area ventilation system does not operate as required.

.4 All HVAC and process equipment shall fail safe if the gas detection or ventilation system fails.

.1 Fuel system valves shall be shut off.

.2 Ventilation system shall be in high air flow mode.

.17 Loss of power

.1 Upon loss of power; all dampers, valves, etc. Shall return to their fail-safe positions.

.2 The air handling unit controller shall retain all information regarding the setpoints and status of operation at the time of power failure.

.3 Upon restoration of power; the air handling unit shall have a delay of 60 seconds prior to restart.

.1 All air handling units shall provide a staggered start operation to minimize electrical demand surge during restart.

.18 Testing/commissioning overrides

.1 Provide software switches that interlock to a chilled water and hot-water plant system level point to perform the following:

.1 Force HW valve full open.

.2 Force HW valve full closed.

.3 Force chilled water valve full open.

.4 Force chilled water valve full closed.

.5 Plant Chilled water supply request.

.6 Plant Hot water supply request.

.19 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.13 AIR HANDLING UNIT AHU-01

.1 General

.1 Unit shall operate as a variable volume air handling unit.

.2 Controls described herein shall be performed by DDC controller using electric actuation and either PI or PID control logic. PI or PID control shall be determined by the applications ability for control tuning. Provide all interface, wiring, relays, interlocks, controls, and programming as required for operation.

.3 Unit shall generally consist, but not limited to, the following:

.1 Supply fan(s), Return fan(s) and Exhaust fan(s) with VFD speed control(s).

.2 Chilled water coil(s).

.3 Heating water coil(s).

.4 Filter sections .

.5 Motorized Outside, Return, Relief air, Economizer / Mixing air dampers.

.6 Air flow stations.

.7 Humidifier section.

.8 Energy recovery wheel.

.9 Bypass dampers.

.4 The air handling unit shall have, as a minimum, the following hardwired connections:

.1 BACNET MS/TP or BACNET IP network interface for monitoring unit operation and performance.

.2 Fire alarm and/or fire protection and/or suppression system.

.3 Safety related items, e.g. high/low temp, pressure, humidity switches….etc.

.2 Building management system (BMS) interface

.1 The DDC field control panel shall communicate virtual points to the BMS.

.2 ALL virtual points shall be mapped to the BMS and shall be readable and/or writeable through the BACNET communications link.

.1 If communication is lost with the BMS, the unit controller shall operate using its last communicated setpoints and run command and an alarm shall be generated.

.3 Scheduling

.1 AHU shall be able to operate continuously (24 hours per day) and or by Operator selectable Schedule.

.2 The unit shall be programmed to be capable of operating in two occupancy modes and various sub-operating modes that shall be made available 24/7 for operation. Refer to the "Zone Groups" and "Zone Groups Operating Modes" descriptions section for operating modes to be made available to the unit. The occupancy modes are as follows:

.1 Occupied mode:

.1 Startup / shutdown

.2 Fan control

.3 Cooling / heating mode

.4 Humidification/ Dehumidification

.5 Economizer mode

.6 Outdoor airflow control

.2 Unoccupied mode

.1 Off

.2 Freeze protection

.4 Startup

.1 Upon a signal from the BMS to start the air handling unit, perform the following:

.1 The return air isolation damper shall be verified open.

.2 Once the return air damper has been verified open, enable the supply air fan(s) and the return air fan(s).

.3 Once the fan(s) have been verified on, modulate open the outside air damper and the relief air damper to maintain sequence of operation setpoints.

.4 Modulate open either the glycol chilled water control valve or modulate the glycol heating water control valve to maintain sequence of operation setpoints.

.5 Modulate the heat wheel

.6 Modulate the humidifier.

.5 Shutdown

.1 Upon a signal from the BMS to shut down the air handling unit, perform the following:

.1 Disable the return air fan(s) and supply air fan(s).

.2 Close the outside air and relief air dampers. Open the return air damper.

.3 While closing the dampers, continue modulating either the glycol chilled water or glycol heating water valves to maintain sequence of operation setpoints.

.4 Once the dampers have been verified as being closed/open, the heating water and chilled water control valves shall be modulated closed.

.5 Disable heat wheel

.6 Disable humidifier.

.6 Fan control

.1 Supply fan(s)

.1 The supply fan(s) shall modulate to maintain duct static pressure setpoint.

.1 Initial setpoint shall be 1.25" (adjustable) at the supply air duct static pressure sensor. Sensors are in the ductwork approximately 2/3 down the main supply air duct (exact location to be coordinated on site during construction. The setpoint shall be adjusted and optimized during testing and balancing.

.2 On a fall in duct static pressure as sensed by the supply air duct static pressure sensor; increase the supply fan speed.

.3 On a rise in static pressure as sensed by the supply air duct static pressure sensor; decrease the supply fan speed.

.2 Return fan(s)

.1 The return fan(s) shall modulate to maintain building supply airflow / return airflow differential flow rates.

.2 During the initial startup, the return air fan(s) shall be controlled to modulate at 500 cfm less (adjustable) than that of the supply fan(s) airflow rate.

.3 During the normal operation of the AHU the return air fan(s) shall be controlled to modulate at 500 cfm less (adjustable) than that of the total supply fan(s) airflow rate and Outdoor total air flow rate to ensure the space is maintained at positive pressure at all times.

.4 The contractor shall record the airflow difference and the building static pressure.

.5 The airflow differential shall be adjusted to maintain a building static pressure of +0.05" at all operating conditions.

.3 Exhaust fan(s)

.1 The exhaust fan(s) shall modulate to maintain building exhaust airflow, and to always maintain the washroom/ locker room at a negative pressure.

.2 Note: during occupied mode the exhaust air flow is constant.

.3 During the normal operation of the AHU the exhaust air fan(s) shall be controlled to modulate between washroom/ locker room exhaust xxx cfm (adjustable) to full return/ exhaust air flow in economizer mode.

.4 The contractor shall record the airflow difference and the static pressure at various modes of operation.

.4 Critical zone static pressure reset

.1 The duct static pressure setpoint shall be reset based on the position of all VAV box dampers pooled by the BMS and to satisfy the critical zone damper.

.2 If the critical zone damper is greater than 95% open (adjustable) then the static pressure setpoint shall be reset upward until the critical zone damper is 90% open (adjustable).

.3 If the critical zone damper is less than 85% open (adjustable) then the static pressure setpoint shall be reset downward until the critical zone damper is 90% open(adjustable).

.4 The above sequence shall be optimized during commissioning process to ensure most energy efficient algorithm is implemented.

.7 Cooling mode

.1 The air handling unit shall be indexed into the cooling mode when the temperature sensed at the mixed air temperature sensor is 55°F (adjustable) or greater. The controls contractor shall make necessary setpoint adjustments to tune the cooling mode / heating / economizer mode switchover in the field.

.2 When indexed into the cooling mode, modulate the chilled water-cooling coil control valve to maintain 55°F (adjustable dependent on VAV box requirements) discharge air temperature as sensed by the supply air discharge temperature sensor.

.8 Heating mode

.1 The air handling unit shall be indexed into the heating mode when the temperature sensed at the mixed air temperature sensor is 54°F (adjustable) or less. The controls contractor shall make necessary setpoint adjustments to tune the cooling / heating / economizer mode switchovers in the field.

.2 When indexed into the heating mode, modulate the hot water heating coil control valve to maintain 65°F (adjustable dependent on VAV box requirements) discharge air temperature as sensed by the supply air discharge temperature sensor.

.3 Refer to the economizer operation for further description of the heating operation.

.4 If the unit is started when the outdoor temperature is less than 54°F (adjustable), the hydronic coil is enabled to modulate and the discharge temperature ramps down gradually to its set point value to prevent the heating safety from undershooting and tripping the low temperature cut-off (time delayed).

.9 Economizer mode

.1 Economizer enable/disable setpoints: on a fall in outdoor air temperature below 68°F (adjustable) and outdoor air enthalpy 2 BTU/lb below return air enthalpy, enable to economizer mode. On a rise in outdoor air temperature above 70 °F (adjustable) or outdoor air enthalpy above return air enthalpy, disable the economizer mode.

.2 Economizer operation:

.1 When the outdoor air condition is between the economizer "On" setpoint and the cooling discharge air setpoint, the outdoor air damper and pressure relief damper shall be modulated up to fully open (refer to building pressurization requirement). Cooling shall operate / modulate to achieve the discharge air setpoint.

.2 Once the outdoor air temperature reaches 55°F, the outdoor air damper and pressure relief damper shall begin to modulate closed while the return air damper begins to modulate open to achieve the discharge air setpoint. Cooling may be disabled during this portion of economizer operation.

.3 At the point the outdoor air damper modulates to the minimum allowable setting, the unit shall enter "Heating Mode" and begin to modulate the hot water heating coil control valve to maintain supply air temperature setpoint.

.4 As the outdoor air temperature rises, the unit mounted controller shall determine the setpoint and conditions the economizer shall be re-enabled, and the sequence shall be reversed.

.10 Outdoor airflow control

.1 The outdoor air damper shall modulate to maintain the minimum outside air ventilation airflow rate as sensed by the outside air airflow station.

.2 Zone CO^2 sensors shall send signals to the BMS. The controller shall determine the critical space CO^2 signal and shall modulate the outside air damper to maintain CO^2 levels within the space within the acceptable range.

.3 Additional Dynamic Reset strategies as defined in ASHRAE 62 shall be implemented. The system shall vary the flow of outdoor air as operating conditions change, thereby reducing the amount of energy needed to condition outdoor air. BMS shall dynamically calculate all system parameters and shall reset fresh air intake flow based on variations in ventilation efficiency (ventilation reset control) and implement / reset VAV zone minimum airflow based on variations in outdoor air fraction due to free cooling or exhaust-air make-up operation.

.11 Energy Recovery wheel rotation

.1 Factory provided rotation sensor that will monitor the energy wheel rotation. A digital signal will be provided if the wheel does not rotate for 30 seconds.

.2 Wheel speed shall be optimized for maximum energy recovery in all operation conditions.

.3 Bypass dampers are modulated to maintain max wheel airflow as per design, and bypass the reminder of the air.

.12 Frost control:

.1 Frost Control for the energy wheel is enabled when frost is present on the wheel; based on the outside air temperature and the pressure drop across the wheel. If the outdoor air temperature is below 5°F (adjustable) and the differential pressure across the wheel is above 1.5" (adjustable and/ or as per manufacturer recommendations) frost control will enable.

.2 When frosting has occurred, the VFD modulates the wheel down to a slow rotational speed to defrost the wheel. Once either the pressure drop decreases below the pressure switch set point, or the outdoor air temperature increases above the temperature set point, the unit will resume normal operation.

.13 Humidity control

.1 The AHU humidifier shall be modulated as required to maintain the desired space humidity set point as sensed by a sensor located in the return air plenum. The relative humidity set point is automatically and proportionally reset by the outdoor air temperature according to the following schedule:

Outdoor Air Temperature	R/A Humidity Set point
20° C	20% RH
+10° C	30% RH

Note: if windows condensation becomes a concern, adjust humidity setpoint accordingly.

.2 The operation of the humidifier shall be overridden if the supply air humidity approaches 60% RH. In addition, an alarm shall be initiated if the supply air humidity exceeds 60% RH.

.3 The unit shall modulate the cooling coil accordingly to maintain space humidity within setpoint range, during summer cooling season without overcooling the space.

.4 Humidity controls and safeties such as air proving switch/ and /or air flow station and high limit humidity shall disable humidifier operation.

.14 Unoccupied "Off" mode

.1 The air handling unit shall be off during this mode. Supply and return fans de-energized, all dampers shall be in their failsafe positions.

.15 Unoccupied "Freeze Protection" mode

.1 During the unoccupied mode, if any single zone falls below 40°F (adjustable); the air handling unit shall be enabled and energized until all zones are above 45°F, and alarm shall be set.

.2 If the air handling unit is turned off, the isolation dampers close, and if the outdoor temperature is low enough, adjustable setpoint 50°F, the glycol heating valves are modulated to maintain an air handling unit cabinet temperature of 45°F, adjustable.

.16 Alarms

.1 Airflow alarm

.1 An airflow stations are provided on supply, return and outdoor air

.2 Level 2 Alarm: Upon a signal to the air fan to be enabled, if the airflow is not proven within 15 seconds (provide delay for damper opening and startup procedures);

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The chilled water and heating water valves shall return to their fail-safe positions

.4 Alarm shall be provided.

.3 Level 3 alarm: upon a signal to the fan to be disabled, if no airflow after 2 minutes, generate a level 3 alarm

.4 Disable/ inhibit humidifier operation (prevent water/ condensation)

.2 Damper position alarms

.1 All dampers shall be provided with position indication.

.2 Level 2 alarm: upon a signal to open the isolation damper, if the position switch does not activate within the installed damper actuator motor drive run time + 10 seconds; generate an alarm.

.3 Filter status alarm

.1 A differential pressure sensor shall monitor the differential pressure across the filters(s).

.2 The maximum filter differential pressure setpoint shall be verified and coordinated with the capabilities of the filter style and filter manufacturer.

.3 Level 4 alarm If the filter differential pressure is greater allowable differential pressure; generate an alarm at the bas & graphic user interface.

.4 Level 3 alarm: if the filter differential pressure is greater than 110% of the calculated allowable differential pressure; generate a level 3 alarm at the bas & graphic user interface.

.4 Freezestat alarm

.1 Level 2 alarm: A freezestat shall be mounted downstream of the hot water heating coil

.2 The freezestat shall use an averaging low temperature detection sensor / switch and be reset manually (reset shall be located at accessible location).

.3 Alarm: upon activation of the freezestat (setpoint shall be 38°f);

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The chilled water and heating water valves shall return to their fail-safe positions

.4 Alarm shall be provided.

.5 High static pressure alarm

.1 A static pressure switches shall be provided and shall be interlocked with the unit’s fans to prevent exploding the ductwork.

.2 The high discharge static pressure switch alarm shall be manually reset (reset shall be located at accessible location).

.3 Level 2 alarm: upon activation of the high-pressure switch;

.1 Deenergize the fan(s).

.2 Dampers shall return to their fail-safe positions.

.3 The chilled water and heating water valves shall return to their fail-safe positions.

.4 Alarm shall be provided.

.6 Fire Alarm:

.1 Fire alarm indication shall be provided

.2 Level 1 alarm: upon activation of the fire alarm signal;

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The chilled water and heating water valves shall return to their fail-safe positions

.4 A signal shall also be sent to the fire alarm control panel

.5 Alarm shall be provided.

.7 Low duct static pressure alarm

.1 A static pressure switches shall be provided and shall be interlocked with the unit's fans to prevent exploding the ductwork.

.2 The low intake static pressure switch alarm shall be manually reset (reset shall be located at accessible location).

.3 Level 2 alarm: upon activation of the low-pressure switch;

.1 Deenergize the fan(s).

.2 Dampers shall return to their fail-safe positions.

.3 The chilled water and heating water valves shall return to their fail-safe positions.

.4 Alarm shall be provided.

.8 Supply air temperature alarm

.1 Software logic shall monitor the discharge supply temperature from the unit.

.2 Level 3 alarm: at the supply air temperature sensor, if the discharge air temperature rises/drops above or below the setpoint temperature by 5 degrees or more for a duration of 15 minutes or more, an alarm shall be generated

.9 Supply air humidity alarm

.1 Software logic shall monitor the discharge supply humidity / dewpoint from the unit.

.2 Level 3 alarm: at the supply air humidity sensor, if the discharge air humidity rises above 66°F dew point for a duration of 15 minutes or more, an alarm shall be generated.

.10 Variable frequency drive fault alarm

.1 Faults generated by an associated variable frequency drive; the unit shall de-energize associated fan(s).

.2 Level 2 alarm: upon report of a fault

.1 Deenergize the associated fan(s).

.2 For multiple supply, multiple return/exhaust fan unit only: The unit shall remain in operation with the remaining fan(s) that are operable.

.3 Alarm shall be provided.

.11 CO^2 sensor alarms

.1 If the CO2 concentration exceeds setpoint plus 10% for more than 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.2 If the CO2 concentration is less than 300 ppm, or the zone is in unoccupied mode for more than 2 hours and the zone CO2 concentration exceeds 600 ppm, generate a level 3 alarm at the BAS & graphic user interface. The alarm text shall identify the sensor and indicate that it may be out of calibration

.12 Frost Control Indication

.1 Level 2 alarm: upon report of a fault or preheater fault

.1 Alarm shall be provided.

.17 Loss of power

.1 Upon loss of power; all dampers, valves, etc. Shall return to their fail-safe positions.

.2 The air handling unit controller shall retain all information regarding the setpoints and status of operation at the time of power failure.

.3 Upon restoration of power; the air handling unit shall have a delay of 60 seconds prior to restart.

.1 All air handling units shall provide a staggered start operation to minimize electrical demand surge during restart.

.18 Testing/commissioning overrides

.1 Provide software switches that interlock to a chilled water and hot-water plant system level point to perform the following:

.1 Force HW valve full open.

.2 Force HW valve full closed.

.3 Force chilled water valve full open.

.4 Force chilled water valve full closed.

.5 Plant Chilled water supply request.

.6 Plant Hot water supply request.

.19 Requests / resets

.1 Chilled water system pressure reset

.2 Terminal unit shall send all required requests made for trim & respond logic chilled water system pressure reset control.

.1 If the CHW valve position > 95%, send 1 request until the CHW valve position is less than 10%. Else, if the CHW valve position < 10%, send 0 requests.

.2 Terminal unit shall send all required position feedback for critical zone PID control logic chilled water system pressure reset control.

.3 Heating hot water system pressure reset

.1 Terminal unit shall send all required requests made for trim & respond logic heating hot-water system pressure reset control.

.1 If the HW valve position > 95%, send 1 request until the HW valve position is less than 10%.

.2 Else, if the HW valve position < 10%, send 0 requests.

.2 Terminal unit shall send all required position feedback for critical zone PID.

.20 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.14 AIR HANDLING UNIT AHU-02-XX

.1 General

.1 To conserve energy and transfer the heat dissipated from the bus electric chargers, this unit shall operate as a backup unit if:

.1 Transfer energy ventilation fans EF-23 to 26 fail to maintain electrical charger rooms space temperature heating and cooling limits (unit complements fans operation),

.2 EF-23 to 26 ventilation system/s is/are disabled/ in fault,

.3 Operator override.

.2 Unit shall operate as a variable volume air handling unit.

.3 Controls described herein shall be performed by DDC controller using electric actuation and either PI or PID control logic. PI or PID control shall be determined by the applications ability for control tuning. Provide all interface, wiring, relays, interlocks, controls, and programming as required for operation.

.4 Unit shall generally consist, but not limited to, the following:

.1 Supply fan(s) and Return fan(s) with VFD speed control(s).

.2 Chilled water coil(s).

.3 Heating water coil(s).

.4 Filter sections.

.5 Motorized Outside, Return, Relief air, Economizer / Mixing air dampers.

.6 Air flow stations.

.5 The air handling unit shall have, as a minimum, the following hardwired connections:

.1 BACNET MS/TP or BACNET IP network interface for monitoring unit operation and performance.

.2 Fire alarm and/or fire protection and/or suppression system.

.3 Safety related items, e.g. high/low temp, pressure, humidity switches….etc.

.2 Building management system (BMS) interface

.1 The DDC field control panel shall communicate virtual points to the BMS.

.2 ALL virtual points shall be mapped to the BMS and shall be readable and/or writeable through the BACNET communications link.

.1 If communication is lost with the BMS, the unit controller shall operate using its last communicated setpoints and run command and an alarm shall be generated.

.3 Scheduling

.1 AHU shall be able to operate continuously (24 hours per day) and or by Operator selectable Schedule.

.2 The unit shall be programmed to be capable of operating in two occupancy modes and various sub-operating modes that shall be made available 24/7 for operation. Refer to the "Zone Groups" and "Zone Groups Operating Modes" descriptions section for operating modes to be made available to the unit. The occupancy modes are as follows:

.1 Occupied mode:

.1 Startup / shutdown

.2 Fan control

.3 Cooling / heating mode

.4 Economizer mode

.5 Outdoor airflow control

.2 Unoccupied mode

.1 Off

.2 Freeze protection

.4 Startup

.1 Upon a signal from the BMS to start the air handling unit, perform the following:

.1 The return air isolation damper shall be verified open.

.2 Once the return air damper has been verified open, enable the supply air fan(s) and the return air fan(s).

.3 Once the fan(s) have been verified on, modulate open the outside air damper and the relief air damper to maintain sequence of operation setpoints.

.4 Modulate open either the glycol chilled water control valve or modulate the glycol heating water control valve to maintain sequence of operation setpoints.

.5 Shutdown

.1 Upon a signal from the BMS to shut down the air handling unit, perform the following:

.1 Disable the return air fan(s) and supply air fan(s).

.2 Close the outside air and relief air dampers. Open the return air damper.

.3 While closing the dampers, continue modulating either the glycol chilled water or glycol heating water valves to maintain sequence of operation setpoints.

.4 Once the dampers have been verified as being closed/open, the heating water and chilled water control valves shall be modulated closed.

.6 Fan control

.1 EF-23 to 26 shall operate to maximize energy recovery from bus electric charger room into the storage garage:

.1 Open fan isolation damper and transfer air damper. Upon confirmation of open dampers status, enable fan to run.

.2 The exhaust fan shall modulate to maintain air flow requirements.

.3 Modulate the supply fan speed from minimum 30% to maximum 100%, as required by cooling and ventilation space requirements.

.4 Electrical charger room space temperature setpoints:

.1 Maintain the following space temperature conditions:

.1 Between 68°F (adjustable) and 80°F (adjustable) no action.

.2 On a call for cooling, room temperature above 80°F:

.1 If the storage garage temperature is lower than the bus electric charger room, and the storage garage system is not in cooling mode, energize the exhaust fan/s to run at low speed, initially set at 35%.

.2 If the temperature in the room continue to rise, then modulate the exhaust fan/s to run at up to 100% to control temperature.

.3 If the storage garage temperature is higher than the bus electric charger room, disable the fan operation, close fan isolation damper and transfer air damper.

.2 Refer to clause 1.13-A-1

.3 The unit supply fan(s) shall modulate to maintain air flow requirements.

.1 Initial setpoint shall be xxx cfm at the supply air flow sensor. The setpoint shall be adjusted and optimized during testing and balancing.

.1 Modulate the supply fan speed from minimum to maximum, as required by heating, cooling, ventilation and or gas detection system.

.4 Unit return fan(s)

.1 The return fan(s) shall modulate to maintain building supply airflow / return airflow differential flow rates, and to maintain the space at positive pressure always.

.2 During the normal operation of the unit the return air fan(s) shall be controlled to modulate at 500 cfm less (adjustable) than that of the total supply fan(s) airflow rate to ensure the space is always maintained at positive pressure.

.5 The fans modulate from minimum low flow setpoint xxx cfm to maximum unit flow.

.6 Fan Redundancy: if an exhaust or supply fan is commanded to be on but is sensed as being off (i.e. no flow and/or VFD current sensed), the BMS shuts down the fan that is off and an alarm is generated to alert the operator of the need for service, AND, if an exhaust or supply fan fails to run (the fan shuts down) the BMS will modulate up its pair trying to maintain max air flow with the remaining fan/s and will modulate down its counterpart fans to ensure negative pressure is maintained in the building at all times, if the speed is required to be modulated down below 25% (or as per manufacturer recommendations) one of the counterpart fans, the counterpart fan shall be commanded to stop running. Note: under a fan failure condition, the HOA switches should be left in

the 'Auto' position to ensure that the proper pressure regime (slight negative) is maintained in the building, system will continue running with one pair of fans. If maintenance is to be performed on the unit, the unit shall be shutdown. Disconnect and lockout power to unit accordingly.

.7 Cooling mode

.1 Refer to clause 1.13-A-1

.2 The air handling unit shall be indexed into the cooling mode when the temperature sensed at the mixed air temperature sensor is 55°F (adjustable) or greater. The controls contractor shall make necessary setpoint adjustments to tune the cooling mode / heating / economizer mode switchover in the field.

.3 When indexed into the cooling mode, modulate the chilled water-cooling coil control valve to maintain 55°F discharge air temperature as sensed by the supply air discharge temperature sensor.

.8 Heating mode

.1 Refer to clause 1.13-A-1.

.2 The heat dissipation from the electrical room shall be sufficient to heat the space, however if no heat dissipation load exist and space heating is required, the exhaust fans EF-23 to 26 and associated intake dampers shall be disabled and AHU shall be enabled to operate.

.3 The air handling unit shall be indexed into the heating mode when the temperature sensed at the mixed air temperature sensor is 54°F (adjustable) or less. The controls contractor shall make necessary setpoint adjustments to tune the cooling / heating / economizer mode switchovers in the field.

.4 When indexed into the heating mode, modulate the hot water heating coil control valve to maintain 80°F discharge air temperature as sensed by the supply air discharge temperature sensor.

.5 Refer to the economizer operation for further description of the heating operation.

.6 If the unit is started when the outdoor temperature is less than 54°F (adjustable), the hydronic coil is enabled to modulate and the discharge temperature ramps down gradually to its set point value to prevent the heating safety from undershooting and tripping the low temperature cut-off (time delayed).

.9 Economizer mode

.1 Economizer enable/disable setpoints: on a fall in outdoor air temperature below 68°F (adjustable), enable to economizer mode. On a rise in outdoor air temperature above 80 °F (adjustable), disable the economizer mode.

.2 Economizer operation:

.1 When the outdoor air condition is between the economizer "On" setpoint and the cooling discharge air setpoint, the outdoor air damper and pressure relief damper shall be modulated up to fully open (refer to building pressurization requirement). Cooling shall operate / modulate to achieve the discharge air setpoint.

.2 Once the outdoor air temperature reaches 55°F, the outdoor air damper and pressure relief damper shall begin to modulate closed while the return air damper begins to modulate open to achieve the discharge air setpoint. Cooling may be disabled during this portion of economizer operation.

.3 At the point the outdoor air damper modulates to the minimum allowable setting, the unit shall enter "Heating Mode" and begin to modulate the hot water heating coil control valve to maintain supply air temperature setpoint.

.4 As the outdoor air temperature rises, the unit mounted controller shall determine the setpoint and conditions the economizer shall be re-enabled, and the sequence shall be reversed.

.10 Outdoor airflow control

.1 The outdoor air damper shall modulate to maintain the minimum outside air ventilation airflow rate as sensed by the outside air airflow station.

.11 Unoccupied "Off" mode

.1 The air handling unit shall be off during this mode. Supply and return fans de-energized, all dampers shall be in their failsafe positions.

.12 Unoccupied "Freeze Protection" mode

.1 During the unoccupied mode, if any single zone falls below 40°F (adjustable); the air handling unit shall be enabled and energized until all zones are above 45°F, and alarm shall be set.

.2 If the air handling unit is turned off, the isolation dampers close, and if the outdoor temperature is low enough, adjustable setpoint 50°F, the glycol heating valves are modulated to maintain an air handling unit cabinet temperature of 45°F, adjustable.

.13 Alarms

.1 Airflow alarm

.1 An airflow stations are provided on supply, return and outdoor air

.2 Level 2 Alarm: Upon a signal to the air fan to be enabled, if the airflow is not proven within 15 seconds (provide delay for damper opening and startup procedures);

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The chilled water and heating water valves shall return to their fail-safe positions

.4 Alarm shall be provided.

.3 Level 3 alarm: upon a signal to the fan to be disabled, if no airflow after 2 minutes, generate a level 3 alarm

.2 Damper position alarms

.1 All dampers shall be provided with position indication.

.2 Level 2 alarm: upon a signal to open the isolation damper, if the position switch does not activate within the installed damper actuator motor drive run time + 10 seconds; generate an alarm.

.3 Filter status alarm

.1 A differential pressure sensor shall monitor the differential pressure across the filters(s).

.2 The maximum filter differential pressure setpoint shall be verified and coordinated with the capabilities of the filter style and filter manufacturer.

.3 Level 4 alarm If the filter differential pressure is greater allowable differential pressure; generate an alarm at the bas & graphic user interface.

.4 Level 3 alarm: if the filter differential pressure is greater than 110% of the calculated allowable differential pressure; generate a level 3 alarm at the bas & graphic user interface.

.4 Freezestat alarm

.1 Level 2 alarm: A freezestat shall be mounted downstream of the hot water heating coil

.2 The freezestat shall use an averaging low temperature detection sensor / switch and be reset manually (reset shall be located at accessible location).

.3 Alarm: upon activation of the freezestat (setpoint shall be 38°f);

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The chilled water and heating water valves shall return to their fail-safe positions

.4 Alarm shall be provided.

.5 Fire Alarm:

.1 Fire alarm indication shall be provided

.2 Level 1 alarm: upon activation of the fire alarm signal

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The chilled water and heating water valves shall return to their fail-safe positions

.4 A signal shall also be sent to the fire alarm control panel

.5 Alarm shall be provided.

.6 Supply air temperature alarm

.1 Software logic shall monitor the discharge supply temperature from the unit.

.2 Level 3 alarm: at the supply air temperature sensor, if the discharge air temperature rises/drops above or below the setpoint temperature by 5 degrees or more for a duration of 15 minutes or more, an alarm shall be generated

.7 Variable frequency drive fault alarm

.1 Faults generated by an associated variable frequency drive; the unit shall de-energize associated fan(s).

.2 Level 2 alarm: upon report of a fault

.1 Deenergize the associated fan(s).

.2 For multiple supply, multiple return/exhaust fan unit only: The unit shall remain in operation with the remaining fan(s) that are operable.

.3 Alarm shall be provided.

.14 Loss of power

.1 Upon loss of power; all dampers, valves, etc. Shall return to their fail-safe positions.

.2 The air handling unit controller shall retain all information regarding the setpoints and status of operation at the time of power failure.

.3 Upon restoration of power; the air handling unit shall have a delay of 60 seconds prior to restart.

.1 All air handling units shall provide a staggered start operation to minimize electrical demand surge during restart.

.15 Testing/commissioning overrides

.1 Provide software switches that interlock to a chilled water and hot-water plant system level point to perform the following:

.1 Force HW valve full open.

.2 Force HW valve full closed.

.3 Force chilled water valve full open.

.4 Force chilled water valve full closed.

.5 Plant Chilled water supply request.

.6 Plant Hot water supply request.

.16 Requests / resets

.1 Chilled water system pressure reset

.1 Terminal unit shall send all required requests made for trim & respond logic chilled water system pressure reset control.

.1 If the CHW valve position > 95%, send 1 request until the CHW valve position is less than 10%. Else, if the CHW valve position < 10%, send 0 requests.

.2 Terminal unit shall send all required position feedback for critical zone PID control logic chilled water system pressure reset control.

.2 Heating hot water system pressure reset

.1 Terminal unit shall send all required requests made for trim & respond logic heating hot-water system pressure reset control.

.1 If the HW valve position > 95%, send 1 request until the HW valve position is less than 10%.

.2 Else, if the HW valve position < 10%, send 0 requests.

.2 Terminal unit shall send all required position feedback for critical zone PID.

.17 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.15 MAKEUP AIR UNIT MUA-XX

.1 General

.1 To conserve energy these units are complementing HRU-01A, B, C operations. These units shall operate if:

.1 HRU-01A, B, C fail to maintain area space temperature heating and cooling limits (unit complements HRUs operation),

.2 HRU-01A, B, C fail to maintain area gas detection limits (unit complements HRUs operation and assist in purge contaminants mode),

.3 HRU-01A, B, C system/s is/are in disabled/ in fault,

.4 Operator override.

.2 Unit shall operate as a variable volume air handling unit and shall be interlocked with its associated external exhaust fans EF-27, 28, 29 accordingly.

.3 Controls described herein shall be performed by DDC controller using electric actuation and either PI or PID control logic. PI or PID control shall be determined by the applications ability for control tuning. Provide all interface, wiring, relays, interlocks, controls, and programming as required for operation.

.4 Unit shall generally consist, but not limited to, the following:

.1 Supply fan(s) with VFD speed control(s).

.2 External exhaust fans EF-27, 28, 29 with VFD speed control(s).

.3 Gas fired section.

.4 Filter sections.

.5 Motorized Outside, exhaust air dampers.

.6 Air flow stations.

.5 The air handling unit shall have, as a minimum, the following hardwired connections:

.1 BACNET MS/TP or BACNET IP network interface for monitoring unit operation and performance.

.2 Fire alarm and/or fire protection and/or suppression system.

.3 Safety related items, e.g. high/low temp, pressure, humidity switches….etc.

.2 Building management system (BMS) interface

.1 The DDC field control panel shall communicate virtual points to the BMS.

.2 ALL virtual points shall be mapped to the BMS and shall be readable and/or writeable through the BACNET communications link.

.1 If communication is lost with the BMS, the unit controller shall operate using its last communicated setpoints and run command and an alarm shall be generated.

.3 Scheduling

.1 These units are complementing HRU-01A, B, C operations and shall be able to operate continuously (24 hours per day) and or by Operator selectable Schedule.

.2 The unit shall be programmed to be capable of operating in two occupancy modes and various sub-operating modes that shall be made available 24/7 for operation. Refer to the "Zone Groups" and "Zone Groups Operating Modes" descriptions section for operating modes to be made available to the unit. The occupancy modes are as follows:

.1 Occupied mode:

.1 Startup / shutdown

.2 Fan control

.3 Cooling / heating mode

.2 Unoccupied mode

.1 Off

.2 Freeze protection

.4 Startup

.1 Upon a signal from the BMS to start the air handling unit, perform the following:

.1 The unit and associated EF-27, 28 or 29 isolation dampers shall be verified open.

.2 Once the air damper has been verified open, enable the supply air fan(s) and the associated EF-27, 28 or 29.

.3 Modulate the gas fired heating section to maintain sequence of operation setpoints.

.5 Shutdown

.1 Upon a signal from the BMS to shut down the air handling unit, perform the following:

.1 Disable the fan(s) and the associated EF-27, 28 or 29.

.2 Close the isolation air dampers.

.3 Once the dampers have been verified as being closed, the gas fired heating section shall be modulated closed.

.6 Fan control

.1 EF-27, 28 or 29

.1 The exhaust fan shall modulate to maintain air flow requirements.

.1 Initial setpoint shall be xxx cfm at the exhaust air flow sensor. The setpoint shall be adjusted and optimized during testing and balancing.

.2 Modulate the supply fan speed from minimum to maximum, as required by heating, cooling, ventilation and or gas detection system.

.1 Refer to HRUs sequence of operation.

.2 Supply fan(s)

.1 The supply fan(s) shall modulate to maintain building supply airflow differential flow rates, and to maintain the space at negative pressure always.

.2 During the normal operation of the unit the supply air fan(s) shall be controlled to modulate at 500 cfm less (adjustable) than that of the total exhaust fan airflow rate to ensure the space is always maintained at negative pressure.

.3 The fans modulate from minimum low flow setpoint xxx cfm to maximum unit flow.

.7 Cooling mode or Ventilation mode or Gas Detection mode

.1 Refer to HRUs sequence of operation.

.2 Refer to clause 1.14-A-1

.3 If HRUs cannot maintain space temperature, enable unit and associated exhaust fan to operate and modulate air flow from minimum to maximum to satisfy space requirements.

.8 Heating mode

.1 Refer to HRUs sequence of operation.

.2 Refer to clause 1.14-A-1

.3 If HRUs cannot maintain space temperature, enable unit and associated exhaust fan to operate, discharge temperature shall be higher than space setpoint (up to maximum recommended by the manufacturer) and modulate air flow from minimum to maximum to satisfy space requirements.

.4 Note: the gas fired unit is designed to start operation at winter design temperature of -35C without tripping the freezestat, which should be disabled, timed out for startup.

.9 Unoccupied "Off" mode

.1 The air handling unit shall be off during this mode. Supply and return fans de-energized, all dampers shall be in their failsafe positions.

.10 Unoccupied "Freeze Protection" mode

.1 Refer to HRUs sequence of operation.

.2 Refer to clause 1.14-A-1

.3 During the unoccupied mode, if any single zone falls below 40°F (adjustable); the air handling unit and associated exhaust fan shall be enabled and energized until all zones are above 45°F, and alarm shall be set.

.11 Alarms

.1 Airflow alarm

.1 An airflow stations are provided on supply, exhaust air

.2 Level 2 Alarm: Upon a signal to the air fan to be enabled, if the airflow is not proven within 15 seconds (provide delay for damper opening and startup procedures);

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The gas fired section shall purge and return to fail-safe position

.4 Alarm shall be provided.

.3 Level 3 alarm: upon a signal to the fan to be disabled, if no airflow after 2 minutes, generate a level 3 alarm

.2 Damper position alarms

.1 All dampers shall be provided with position indication.

.2 Level 2 alarm: upon a signal to open the isolation damper, if the position switch does not activate within the installed damper actuator motor drive run time + 10 seconds; generate an alarm.

.3 Filter status alarm

.1 A differential pressure sensor shall monitor the differential pressure across the filters(s).

.2 The maximum filter differential pressure setpoint shall be verified and coordinated with the capabilities of the filter style and filter manufacturer.

.3 Level 4 alarm If the filter differential pressure is greater allowable differential pressure; generate an alarm at the bas & graphic user interface.

.4 Level 3 alarm: if the filter differential pressure is greater than 110% of the calculated allowable differential pressure; generate a level 3 alarm at the bas & graphic user interface.

.4 Freezestat alarm

.1 Level 2 alarm: A freezestat shall be mounted downstream of the gas fired section

.2 The freezestat shall use an averaging low temperature detection sensor / switch and be reset manually (reset shall be located at accessible location).

.3 Alarm: upon activation of the freezestat (setpoint shall be 38°f);

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The gas fired section shall purge and return to fail-safe position

.4 Alarm shall be provided.

.5 Fire Alarm:

.1 Fire alarm indication shall be provided

.2 Level 1 alarm: upon activation of the fire alarm signal;

.1 Deenergize the fan(s)

.2 Dampers shall return to their fail-safe positions

.3 The gas fired section shall purge and return to fail-safe position

.4 A signal shall also be sent to the fire alarm control panel

.5 Alarm shall be provided.

.6 Supply air temperature alarm

.1 Software logic shall monitor the discharge supply temperature from the unit.

.2 Level 3 alarm: at the supply air temperature sensor, if the discharge air temperature rises/drops above or below the setpoint temperature by 5 degrees or more for a duration of 15 minutes or more, an alarm shall be generated

.7 Variable frequency drive fault alarm

.1 Faults generated by an associated variable frequency drive; the unit shall de-energize associated fan(s).

.2 Level 2 alarm: upon report of a fault

.1 Deenergize the associated fan(s).

.2 For multiple supply, multiple return/exhaust fan unit only: The unit shall remain in operation with the remaining fan(s) that are operable.

.3 Alarm shall be provided.

.12 Loss of power

.1 Upon loss of power; all dampers, valves, etc. Shall return to their fail-safe positions.

.2 The air handling unit controller shall retain all information regarding the setpoints and status of operation at the time of power failure.

.3 Upon restoration of power; the air handling unit shall have a delay of 60 seconds prior to restart.

.1 All air handling units shall provide a staggered start operation to minimize electrical demand surge during restart.

.13 Loss of power:

.1 The unit and associated exhaust fan shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit and associated exhaust fan shall return to the status and operation being performed prior to the power failure.

1.16 FAN COIL UNIT (FCU- XX) WITH/ WITHOUT PERIMETER HEAT

.1 General

.1 Units shall operate intermittently as required to maintain space temperature and humidity conditions.

.2 Provide all interface, wiring, relays, interlocks, controls, and programming as required for interfacing and operation of the AC units pre-packaged control system.

.2 Unit shall generally consist of the following:

.1 Supply fan(s) with speed control.

.2 Chilled glycol

.3 Glycol heating coil.

.4 Filter section.

.5 All required sensors and transmitters.

.3 The unit shall have the following hardwired connections:

.1 BACNET MS/TP network interface or BACNET ethernet network interface for monitoring unit operation and performance.

.4 The BMS shall monitor temperatures and setpoints

.5 If communication is lost with the BMS, the unit controller shall operate using its last communicated setpoints and run command and an alarm shall be generated.

.6 Scheduling

.1 Unit shall be able to operate continuously (24 hours per day) and or by Operator selectable Schedule.

.2 The unit shall be programmed to be capable of operating in two occupancy modes and various sub-operating modes that shall be made available 24/7 for operation. Refer to the "Zone Groups" and "Zone Groups Operating Modes" descriptions section for operating modes to be made available to the unit. The occupancy modes are as follows:

.1 Occupied mode:

.1 Startup / shutdown

.2 Fan control

.3 Cooling / heating mode

.2 Unoccupied mode

.1 Off

.2 Freeze protection

.7 Space setpoints:

.1 During occupied mode, morning warm-up, or morning cool-down mode, maintain the following space temperature conditions and minimum space airflow setpoint:

.1 Cooling: Space temperature set point of 75°F (adjustable).

.2 Heating: Space temperature set point of 72°F (adjustable).

.2 During unoccupied mode, maintain the following space temperature conditions and minimum airflow setpoint.

.1 Cooling: Space temperature set point of 85°F (adjustable).

.2 Heating: Space temperature set point of 65°F (adjustable).

.8 Fan start/stop control:

.1 On call to run for heating or cooling, energize the fan to run.

.2 Simultaneously, the heating or cooling water control valve shall modulate open.

.3 Once space temperature has been satisfied; the heating or cooling water control valve shall modulate closed.

.9 Heating:

.1 On a fall in space temperature below set point, modulate the heating water control valve towards the open position.

.2 On a rise in space temperature, modulate the heating water control valve towards the closed position.

.3 Heating with perimeter / radiant heat:

.1 Once the DAT reaches the space setpoint temperature, the perimeter heating valve shall modulate open.

.2 Once the perimeter heating valve reaches 100% open, the discharge air temperature (DAT) shall continue to rise until the maximum discharge air temperature.

.3 On a drop in space temperature; reverse the sequence.

.10 Cooling:

.1 On a rise in space temperature above set point, modulate the cooling water control valve towards the open position.

.2 On a fall in space temperature, modulate the cooling water control valve towards the closed position.

.11 Space temperature set point & mode adjustment:

.1 Allow set point adjustment at space temperature sensor and limit adjustment to ± 3°F.

.2 Unoccupied mode override push button: upon activation of the space sensor unoccupied mode override push button, operate occupied and disable demand controlled ventilation for 60 minutes.

.12 Deadband

.1 Provide adequate deadband to prevent short cycling of the unit.

.13 Alarms and events

.1 Unit fan failure alarm:

.1 Level 2 alarm: on failure to run, disable the unit heater fan and send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.2 Space/zone temperature alarm

.1 High-temperature alarm

.1 Level 3 alarm: If the space/zone is 3°F above cooling setpoint for 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.2 Level 2 alarm: If the space/zone is 5°F above cooling setpoint for 10 minutes, generate a level 2 alarm at the BAS & graphic user interface.

.2 Low-temperature alarm

.1 Level 3 alarm: if the space/zone is 3°f below heating setpoint for 10 minutes, generate a level 3 alarm at the bas & graphic user interface.

.2 Level 2 alarm: if the space/zone is 5°f below heating setpoint for 10 minutes, generate a level 2 alarm at the bas & graphic user interface.

.3 High-temperature and low-temperature alarms shall be suppressed in the following conditions:

.1 Heating or cooling system status of 'Systemok' is reported as 'False'

.2 While the zone group is in 'warm-up' or 'cooldown' modes

.3 Unit general fault alarm

.1 Level 2 alarm: if the unit signals a general fault; generate a level 2 alarm at the BMS & graphic user interface.

.14 Loss of power

.1 Level 2 alarm: if the unit signal a loss of power alarm; generate a level 2 alarm at the BMS & graphic user interface.

.15 BMS disconnection alarm

.1 Level 3 alarm: if the BMS signals connection has been lost between the building control system and the packaged unit controls system; generate a level 3 alarm at the BMS & graphic user interface.

.16 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.17 AIR CURTAINS

.1 General:

.1 Air curtains shall be operated to minimize heat loss, or heat gain for air-conditioned spaces, of the space.

.2 Air curtains shall be enabled to operate to significantly reduce facility energy consumption.

.3 Notes:

.1 Do not disable air curtain operation unless for maintenance purposes.

.2 Scheduling:

.1 Year round.

.2 As required locally by the Operator.

.3 Air Curtain start/stop control:

.1 Operator shall select the On/Off mode and the actual air curtain fan speed.

.2 Built in control system based on overhead door open indication end switch.

.1 Enable air curtain operation as soon as door is sensed “opening” and no delay start timers.

.4 Alarms

.1 Air Curtain failure alarm

.1 Level 2 alarm: on failure to run/ overload, send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.2 BMS disconnection alarm

.1 Level 3 alarm: if the BMS signal connection has been lost between the building control system and the unit controller; generate a level 3 alarm at the BAS & graphic user interface

.3 Door opens for prolonged time:

.1 Level 3 alarm: If door is held open for longer than 15 min (adjustable), generate a level 3 alarm at the BAS & graphic user interface.

.2 Note: keeping the doors open for prolonged periods of time impact and increase facility energy consumption.

.5 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

1.18 MECHANICAL ROOM VENTILATION SYSTEM

.1 General:

.1 The ventilation system is composed of supply fans SF-01; 04 and EF-11; 12 isolation dampers and recirculation dampers.

.2 The supply and exhaust fans shall operate as a variable volume unit based on local temperature control, manual Operator override or scheduling, unless:

.1 Gas detection is detected triggering Purge mode ventilation.

.3 The system consists of:

.1 Supply and exhaust fans c/w VFDs

.2 Mixing dampers, outdoor air dampers.

.3 Unit heaters.

.4 The system shall maintain temperature and ventilation control.

.2 Scheduling:

.1 Units hall be able to operate continuously (24 hours per day) and or by Operator selectable Schedule.

.2 The unit shall be programmed to be capable of operating in two occupancy modes and various sub-operating modes that shall be made available 24/7 for operation. Refer to the "Zone Groups" and "Zone Groups Operating Modes" descriptions section for operating modes to be made available to the unit. The occupancy modes are as follows:

.1 Occupied mode:

.1 Startup / shutdown

.2 Fan control

.3 Ventilation

.4 Cooling, as applicable

.5 Heating mode

.6 Gas Detection

.2 Unoccupied mode

.1 Off

.2 Freeze protection

.3 Gas Detection

.3 Space temperature setpoints

.1 Maintain the following space temperature conditions:

.1 Between 68°F (adjustable) and 85°F (adjustable), energize the supply and exhaust fans for 10 min every hour (adjustable) to run at low speed, initially set at 30% Air flow stations shall ensure space is maintained at slight negative pressure. Modulate mixing dampers to achieve space temperature. Supply discharge temperature should never be allowed to drop below 55F.

.1 On a call for heating:

.1 If the temperature below 68°F, energize the independent unit heater(s) to run.

.2 Once space temperature has been satisfied; the independent unit heater(s) shall be de-energized.

.2 On a call for cooling, room temperature above 85°F (adjustable):

.1 Energize the supply and exhaust fans to run at low speed, initially set at 30%. Air flow stations shall ensure space is maintained at slight negative pressure.

.2 Modulate open the outdoor air and exhaust air dampers, modulate close the room recirculation air dampers up to 100% outdoor air and exhaust air to maintain setpoint. Supply discharge temperature should never be allowed to drop below 55F.

.3 If the temperature in the room continue to rise, modulate the supply and exhaust fans to run at up to 100%. Air flow stations shall ensure space is maintained at slight negative pressure.

.4 Once space temperature has been satisfied; the supply and exhaust fans shall modulate down to 30%.

.4 Purge mode –gas detection:

.1 Gas detection sensors are installed throughout the space.

.2 The gas detection system shall be used for activating the ventilation system and alarms as follows:

.1 If the ventilation system is in “off “mode, energize both exhaust fans and supply fans, and

.2 Modulate open the outdoor air and exhaust air dampers, modulate close the room recirculation air dampers up to 100% outdoor air and exhaust air, and:

.1 Initially at low fans speed upon gas concentrations reaching Low limits

.2 Increase fans to maximum speed upon gas concentrations rise to High limits,

.3 Trigger evacuation alarms upon gas concentrations rising to the System alarm limits.

.3 The ventilation system shall run in purge mode until the gas concentration is lowered below the lower limit and continue to operate for 30 minutes (adjustable).

.3 During purge mode inhibit room temperature control sequence. Room temperature should not drop below 38F, energize unit heaters.

.4 Activate audio and visual alarms in the area. The audible alarm shall be recognizable and may be stopped by the authorized personnel, whereas the visual device shall stay in operation as long as the detection system is in alarm.

.1 Low Limits:

.1 CO = 15 ppm

.2 NO2 = 1 ppm

.2 High Limits:

.1 CO => 25 ppm

.2 NO2 => 2 ppm

.3 System Alarm Limits:

.1 CO => 100 ppm

.2 NO2 => 3 ppm

.5 Supply and Exhaust fan start/stop control:

.1 On call to run, mixing dampers shall be in normal position (recirculation).

.2 Once the damper verified "Open", energize the supply and exhaust fans to run at low speed (speed control as described in heating and cooling mode above).

.3 On a call to stop, deenergize the supply and exhaust fans and modulate air dampers to normal position.

.6 Alarms

.1 Variable frequency drive fault alarm

.1 Faults generated by an associated variable frequency drive; the unit shall de-energize associated fan(s).

.2 Level 2 alarm: upon report of a fault

.1 Deenergize the associated fan(s).

.2 Damper alarm

.1 Level 2 alarm: on failure to verify damper 'Open' position when the fan is enabled, disable the fan and send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.3 Filter status alarm

.1 A differential pressure sensor shall monitor the differential pressure across the filters(s).

.2 The maximum filter differential pressure setpoint shall be verified and coordinated with the capabilities of the filter style and filter manufacturer.

.3 Level 4 alarm If the filter differential pressure is greater allowable differential pressure; generate an alarm at the bas & graphic user interface.

.4 Level 3 alarm: if the filter differential pressure is greater than 110% of the calculated allowable differential pressure; generate a level 3 alarm at the bas & graphic user interface.

.4 CO/ NO2:

.1 Level 1 alarm: High Limit

.2 Level 2 alarm: Low limit

.3 NOTE: Further actions, e.g. evacuate the facility, shall be taken by the operator according to all facility Safety and Operating Procedures.

.7 Space/zone temperature alarm

.1 Low-temperature alarm

.1 level 3 alarm: if the space/zone is 10°F below heating lower limit setpoint for 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.2 level 2 alarm: if the space/zone is 20°F below heating lower limit setpoint for 10 minutes, generate a level 2 alarm at the BAS & graphic user interface.

.3 Low-temperature alarms shall be suppressed in the following conditions:

.1 heating system status of 'Systemok' is reported as 'False'

.2 High-temperature alarm

.1 level 3 alarm: if the space/zone is 10°F above cooling setpoint for 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.2 level 2 alarm: if the space/zone is 20°F above cooling setpoint for 10 minutes, generate a level 2 alarm at the BAS & graphic user interface.

.3 BMS disconnection alarm

.1 Level 3 alarm: if the BMS signal connection has been lost between the building control system and the unit controller; generate a level 3 alarm at the BAS & graphic user interface

.8 Fire Alarm:

.1 Fire alarm indication shall be provided

.2 Level 1 alarm: upon activation of the fire alarm signal;

.3 Deenergize the fan(s)

.4 Dampers shall return to their fail-safe positions

.5 A signal shall also be sent to the fire alarm control panel

.6 Alarm shall be provided.

.9 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.19 AUXILARY VEHICLE ROOM VENTILATION SYSTEM

.1 General:

.2 The ventilation system is composed of supply fans SF-02; 03 and EF-17; 22 isolation dampers.

.3 The supply and exhaust fans shall operate as a variable volume unit based on local temperature control, manual Operator override or scheduling, unless:

.4 Gas detection is detected triggering Purge mode ventilation.

.5 The system consists of:

.6 Supply and exhaust fans c/w VFDs

.7 Outdoor and exhaust air dampers.

.8 Unit heaters.

.9 The system shall maintain temperature and ventilation control.

.2 Scheduling:

.1 Units hall be able to operate continuously (24 hours per day) and or by Operator selectable Schedule.

.2 The unit shall be programmed to be capable of operating in two occupancy modes and various sub-operating modes that shall be made available 24/7 for operation. Refer to the "Zone Groups" and "Zone Groups Operating Modes" descriptions section for operating modes to be made available to the unit. The occupancy modes are as follows:

.3 Occupied mode:

.4 Startup / shutdown

.5 Fan control

.6 Ventilation

.7 Cooling, as applicable

.8 Heating mode

.9 Gas Detection

.10 Unoccupied mode

.11 Off

.12 Freeze protection

.13 Gas Detection

.3 Space temperature setpoints

.1 Maintain the following space temperature conditions:

.2 Between 68°F (adjustable) and 85°F (adjustable), energize the supply and exhaust fans for 10 min every hour (adjustable) to run at low speed, initially set at 30% Air flow stations shall ensure space is maintained at slight negative pressure. Modulate mixing dampers to achieve space temperature. Supply discharge temperature should never be allowed to drop below 55F.

.3 On a call for heating:

.4 If the temperature below 68°F, energize the independent unit heater(s) to run.

.5 Once space temperature has been satisfied; the independent unit heater(s) shall be de-energized.

.6 On a call for cooling, room temperature above 85°F (adjustable):

.7 Energize the supply and exhaust fans to run at low speed, initially set at 30%. Air flow stations shall ensure space is maintained at slight negative pressure.

.8 If the temperature in the room continue to rise, modulate the supply and exhaust fans to run at up to 100%. Air flow stations shall ensure space is maintained at slight negative pressure.

.9 Once space temperature has been satisfied; the supply and exhaust fans shall modulate down to 30%.

.4 Purge mode –gas detection:

.1 Gas detection sensors are installed throughout the space.

.2 The gas detection system shall be used for activating the ventilation system and alarms as follows:

.3 If the ventilation system is in “off “mode, energize both exhaust fans and supply fans, and

.4 Open outdoor air and exhaust air dampers, and:

.5 Initially at low fans speed upon gas concentrations reaching Low limits

.6 Increase fans to maximum speed upon gas concentrations rise to High limits,

.7 Trigger evacuation alarms upon gas concentrations rising to the System alarm limits.

.8 The ventilation system shall run in purge mode until the gas concentration is lowered below the lower limit and continue to operate for 30 minutes (adjustable).

.9 During purge mode inhibit room temperature control sequence. Room temperature should never be allowed to drop below 38F, energize unit heaters.

.10 Activate audio and visual alarms in the area. The audible alarm shall be recognizable and may be stopped by the authorized personnel, whereas the visual device shall stay in operation as long as the detection system is in alarm.

.11 Low Limits:

.12 CO = 15 ppm

.13 NO2 = 1 ppm

.14 High Limits:

.15 CO => 25 ppm

.16 NO2 => 2 ppm

.17 System Alarm Limits:

.18 CO => 100 ppm

.19 NO2 => 3 ppm

.5 Supply and Exhaust fan start/stop control:

.1 Once the damper verified "Open", energize the supply and exhaust fans to run at low speed (speed control as described in heating and cooling mode above).

.2 On a call to stop, deenergize the supply and exhaust fans and modulate air dampers to normal position.

.6 Alarms

.1 Variable frequency drive fault alarm

.2 Faults generated by an associated variable frequency drive; the unit shall de-energize associated fan(s).

.3 Level 2 alarm: upon report of a fault

.4 Deenergize the associated fan(s).

.5 Damper alarm

.6 Level 2 alarm: on failure to verify damper 'Open' position when the fan is enabled, disable the fan and send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.7 Filter status alarm

.8 A differential pressure sensor shall monitor the differential pressure across the filters(s).

.9 The maximum filter differential pressure setpoint shall be verified and coordinated with the capabilities of the filter style and filter manufacturer.

.10 Level 4 alarm If the filter differential pressure is greater allowable differential pressure; generate an alarm at the bas & graphic user interface.

.11 Level 3 alarm: if the filter differential pressure is greater than 110% of the calculated allowable differential pressure; generate a level 3 alarm at the bas & graphic user interface.

.12 CO/ NO2:

.13 Level 1 alarm: High Limit

.14 Level 2 alarm: Low limit

.15 NOTE: Further actions, e.g. evacuate the facility, shall be taken by the operator according to all facility Safety and Operating Procedures.

.7 Space/zone temperature alarm

.1 Low-temperature alarm

.2 level 3 alarm: if the space/zone is 10°F below heating lower limit setpoint for 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.3 level 2 alarm: if the space/zone is 20°F below heating lower limit setpoint for 10 minutes, generate a level 2 alarm at the BAS & graphic user interface.

.4 Low-temperature alarms shall be suppressed in the following conditions:

.5 heating system status of 'Systemok' is reported as 'False'

.6 High-temperature alarm

.7 level 3 alarm: if the space/zone is 10°F above cooling setpoint for 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.8 level 2 alarm: if the space/zone is 20°F above cooling setpoint for 10 minutes, generate a level 2 alarm at the BAS & graphic user interface.

.9 BMS disconnection alarm

.10 Level 3 alarm: if the BMS signal connection has been lost between the building control system and the unit controller; generate a level 3 alarm at the BAS & graphic user interface

.8 Fire Alarm:

.1 Fire alarm indication shall be provided

.2 Level 1 alarm: upon activation of the fire alarm signal;

.3 Deenergize the fan(s)

.4 Dampers shall return to their fail-safe positions

.5 A signal shall also be sent to the fire alarm control panel

.6 Alarm shall be provided.

.9 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.20 BATTERY ROOM VENTILATION SYSTEM

.1 General:

.1 The ventilation system is composed of a duty EF-18; 19 and standby exhaust fans EF-20; 21, isolation dampers, outdoor and transfer air dampers.

.2 The exhaust fans shall operate continuously as a variable volume unit based on local temperature control, manual Operator override and gas detection, triggering Purge mode ventilation.

.3 The system consists of:

.4 Exhaust fans c/w VFDs

.5 Outdoor, transfer and exhaust air dampers.

.6 Unit heaters.

.7 The system shall maintain temperature and ventilation control.

.2 Scheduling:

.1 Unit shall be able to operate continuously (24 hours per day).

.2 Battery room shall be provided with a variable continuous ventilation system.

.3 The unit shall be programmed to be capable of as follows:

.1 Startup / shutdown

.2 Duty/ standby

.3 Fan control

.4 Ventilation

.5 Cooling, as applicable

.6 Heating mode

.7 Gas Detection

.8 Freeze protection

.3 Minimum ventilation rate:

.1 The system shall operate continuously at minimum ventilation rate.

.2 Minimum ventilation rate shall be maintained at 1cfm/ft2 in each battery room (approximately 1,000 cfm). Exhaust shall be from lower and higher elevations.

.3 During HRU-6 operation, serving the adjacent store and parts area, the transfer damper from the store and parts area shall be open, and outdoor air damper shall be maintained open approximately 10%.

.4 If HRU-6 in not in operation, the transfer damper from the store and parts area shall be closed, outdoor air damper shall modulate from minimum to maximum open position dependent of exhaust fan air flow requirements.

.4 Space temperature setpoints

.1 Maintain the following space temperature conditions:

.1 Between 68°F (adjustable) and 85°F (adjustable), run exhaust fan at low speed.

.2 On a call for heating:

.1 If the temperature below 68°F, energize the independent unit heater(s) to run.

.2 Once space temperature has been satisfied; the independent unit heater(s) shall be de-energized.

.2 On a call for cooling, room temperature above 85°F (adjustable):

.1 Energize exhaust fans to run at low speed, set at 30%. Air flow stations shall ensure space is maintained at slight negative pressure.

.2 If the temperature in the room continue to rise, modulate the outdoor air damper and fan to run at up to 100%. Air flow stations shall ensure space is maintained at slight negative pressure.

.3 Once space temperature has been satisfied; the exhaust fans shall modulate down to minimum air flow requirements.

.5 Purge mode – H2 gas detection:

.1 Gas detection sensors are installed throughout the space.

.2 The gas detection system shall be used for enhancing the ventilation system and alarms as follows:

.1 Open outdoor air 100%, and:

.1 Initially at low fans speed upon gas concentrations reaching Low limits

.2 Increase fans to maximum speed upon gas concentrations rise to High limits,

.3 Trigger evacuation alarms upon gas concentrations rising to the System alarm limits.

.2 The ventilation system shall run in purge mode until the gas concentration is lowered below the lower limit and continue to operate for 30 minutes (adjustable).

.3 During purge mode inhibit room temperature control sequence. Room temperature should not drop below 38F, energize unit heaters.

.4 Activate audio and visual alarms in the area. The audible alarm shall be recognizable and may be stopped by the authorized personnel, whereas the visual device shall stay in operation as long as the detection system is in alarm.

.1 Low Limits:

.1 10% LEL

.2 High Limits:

.1 20% LEL

.3 System Alarm Limits:

.1 25% LEL

.6 Exhaust fan start/stop control:

.1 Once the damper verified "Open", energize exhaust fans to run at low speed (speed control as described in heating and cooling mode above).

.2 On a call to stop, deenergize the exhaust fans and modulate air dampers to normal position.

.3 If duty fan fails, automatically changeover to standby fan.

.4 Rotate duty standby units every month (operator adjustable).

.7 Alarms

.1 Variable frequency drive fault alarm

.1 Faults generated by an associated variable frequency drive; the unit shall de-energize associated fan(s).

.2 Level 2 alarm: upon report of a fault

.1 Deenergize the associated fan(s).

.2 Damper alarm

.1 Level 2 alarm: on failure to verify damper 'Open' position when the fan is enabled, disable the fan and send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.3 Filter status alarm

.1 A differential pressure sensor shall monitor the differential pressure across the filters(s).

.2 The maximum filter differential pressure setpoint shall be verified and coordinated with the capabilities of the filter style and filter manufacturer.

.3 Level 4 alarm If the filter differential pressure is greater allowable differential pressure; generate an alarm at the bas & graphic user interface.

.4 Level 3 alarm: if the filter differential pressure is greater than 110% of the calculated allowable differential pressure; generate a level 3 alarm at the bas & graphic user interface.

.4 H2 alarm:

.1 Level 1 alarm: High Limit

.2 Level 2 alarm: Low limit

.3 NOTE: Further actions, e.g. evacuate the facility, shall be taken by the operator according to all facility Safety and Operating Procedures.

.8 Space/zone temperature alarm

.1 Low-temperature alarm

.1 level 3 alarm: if the space/zone is 10°F below heating lower limit setpoint for 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.2 level 2 alarm: if the space/zone is 20°F below heating lower limit setpoint for 10 minutes, generate a level 2 alarm at the BAS & graphic user interface.

.3 Low-temperature alarms shall be suppressed in the following conditions:

.1 heating system status of 'Systemok' is reported as 'False'

.2 High-temperature alarm

.1 level 3 alarm: if the space/zone is 10°F above cooling setpoint for 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.2 level 2 alarm: if the space/zone is 20°F above cooling setpoint for 10 minutes, generate a level 2 alarm at the BAS & graphic user interface.

.3 BMS disconnection alarm

.1 Level 3 alarm: if the BMS signal connection has been lost between the building control system and the unit controller; generate a level 3 alarm at the BAS & graphic user interface

.9 Fire Alarm:

.1 Fire alarm indication shall be provided

.2 Level 1 alarm: upon activation of the fire alarm signal;

.3 Deenergize the fan(s)

.4 Dampers shall return to their fail-safe positions

.5 A signal shall also be sent to the fire alarm control panel

.6 Alarm shall be provided.

.10 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.21 EXHAUST FANS VFD AND/ OR ECM (VARIOUS ROOM)

.1 General:

.1 The exhaust fan shall operate as a variable volume unit based on local temperature control and manual Operator override.

.2 Space temperature setpoints

.1 Maintain the following space temperature conditions:

.1 Between 68°F (adjustable) and 80°F (adjustable) no action.

.2 On a call for heating, temperature below 68°F, energize the independent unit heater to run.

.3 Once space temperature has been satisfied; the independent unit heater shall be de-energized

.4 On a call for cooling, temperature above 80°F, energize the exhaust fan to run.

.5 Once space temperature has been satisfied; the exhaust fan shall be de-energized

.3 Exhaust fan start/stop control:

.1 On call to run, open the exhaust fan isolation damper and outdoor air intake damper.

.2 Once the exhaust fan isolation damper and outdoor air intake damper are verified "Open", energize the exhaust fan to run at low speed, 25%.

.3 If temperature setpoint is not satisfied increase fan speed gradually up to 100% speed.

.4 Reverse sequence shall occur if temperature decreases.

.5 On a call to stop, deenergize the exhaust fan and close the exhaust air damper and outdoor air intake damper.

.4 Alarms

.1 Variable frequency drive or ECM motor fault alarm

.1 Faults generated by an associated variable frequency drive or ECM; the unit shall de-energize associated fan

.2 Level 2 alarm: on failure to run, disable the exhaust fan and send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.2 Exhaust fan damper alarm

.1 Level 2 alarm: on failure to verify damper 'Open' position when the exhaust fan is enabled, disable the exhaust fan and send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.3 Filter status alarm

.1 A differential pressure sensor shall monitor the differential pressure across the filters(s).

.2 The maximum filter differential pressure setpoint shall be verified and coordinated with the capabilities of the filter style and filter manufacturer.

.3 Level 4 alarm If the filter differential pressure is greater allowable differential pressure; generate an alarm at the bas & graphic user interface.

.4 Level 3 alarm: if the filter differential pressure is greater than 110% of the calculated allowable differential pressure; generate a level 3 alarm at the bas & graphic user interface.

.5 Space/zone temperature alarm

.1 High-temperature alarm

.1 level 3 alarm: if the space/zone is 10°F above cooling setpoint for 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.2 level 2 alarm: if the space/zone is 20°F above cooling setpoint for 10 minutes, generate a level 2 alarm at the BAS & graphic user interface.

.2 BMS disconnection alarm

.1 Level 3 alarm: if the BMS signal connection has been lost between the building control system and the unit heater controller; generate a level 3 alarm at the BAS & graphic user interface

.6 Fire Alarm:

.1 Fire alarm indication shall be provided

.2 Level 1 alarm: upon activation of the fire alarm signal;

.3 Deenergize the fan(s)

.4 Dampers shall return to their fail-safe positions

.5 A signal shall also be sent to the fire alarm control panel

.6 Alarm shall be provided.

.7 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.22 EXHAUST FANS (EF-05, 07, 10, 15)

.1 General:

.1 The exhaust fan shall operate as a constant volume unit.

.2 Scheduling:

.1 As required locally by the Operator

.3 Exhaust fan start/stop control:

.1 Built in control system based on Operator initiation and local exhaust drop activation.

.4 Alarms

.1 Exhaust fan failure alarm

.1 Level 2 alarm: on failure to run, disable the exhaust fan and send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.2 BMS disconnection alarm

.1 Level 3 alarm: if the BMS signal connection has been lost between the building control system and the unit controller; generate a level 3 alarm at the BAS & graphic user interface

.5 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

1.23 AIR CONDITIONING (ELECTRICAL ROOMS):

.1 General

.1 To conserve energy and transfer the heat dissipated from the electrical room, these unit shall operate as a backup unit if:

.1 Transfer energy ventilation fans EF-30 to 31 fail to maintain electrical rooms space temperature heating and cooling limits (units complement fans operation),

.2 EF-30 to 31 ventilation system/s is/are disabled/ in fault,

.3 Operator override.

.2 Units shall operate intermittently as required to maintain space temperature and indirectly humidity conditions.

.3 Provide all interface, wiring, relays, interlocks, controls, and programming as required for interfacing and operation of the AC units pre-packaged control system.

.2 Unit shall generally consist of the following:

.1 Supply fan(s) with speed control.

.2 DX refrigerant coil with remote outdoor condensing unit.

.3 Heating by electric heating coil or heatpump operation, or independent electrical unit heater.

.4 Filter section.

.5 All required sensors and transmitters.

.6 Pre-packaged control system.

.3 The air-conditionings unit shall have the following hardwired connections:

.1 BACNET MS/TP network interface or BACNET ethernet network interface for monitoring unit operation and performance.

.4 The BMS shall monitor temperatures and setpoints

.5 If communication is lost with the BMS, the unit controller shall operate using its last communicated setpoints and run command and an alarm shall be generated.

.6 Scheduling

.1 unit's system shall be scheduled and enabled to operate continuously (24 hours per day).

.7 Space conditioning setpoints

.1 Temperature setpoint: 78°F ±5°F

.2 Temperature deadband: 4°F

.3 Humidity: 45% +5% (indirectly by cooling mode)

.8 Startup / shutdown

.1 Startup and shutdown shall be sequenced by the BAS through the unit manufacturer packaged control system.

.2 Redundancy: Rooms that are equipped with multiple air conditioning units have built in 50 to 70% redundancy, therefore:

.1 Enable the duty unit/s first

.2 If space temperature is not satisfied after 15 minutes, enable the other standby units to start.

.3 Rotate duty standby units every month (operator adjustable).

.9 Fan operation

.1 EF-30 to 31 shall operate to maximize energy recovery from electric room into the storage garage/ stores and parts rooms:

.1 Open fan isolation damper and transfer air damper. Upon confirmation of open dampers status, enable fan to run.

.2 The exhaust fan shall modulate to maintain air flow requirements.

.3 Modulate the supply fan speed from minimum 30% to maximum 100%, as required by cooling and ventilation space requirements.

.4 Electrical room space temperature setpoints:

.1 Maintain the following space temperature conditions:

.1 Between 68°F (adjustable) and 780°F (adjustable) no action.

.2 On a call for cooling, room temperature above 78°F:

.1 If the storage garage/ stores and parts rooms temperature is lower than the electric room, and the storage garage/ stores and parts rooms system is not in cooling mode, energize the exhaust fan/s to run at low speed, initially set at 35%.

.2 If the temperature in the room continue to rise, then modulate the exhaust fan/s to run at up to 100% to control temperature.

.3 If the storage garage/ stores and parts rooms temperature is higher than the electric room, disable the fan operation, close fan isolation damper and transfer air damper.

.2 Refer to clause 1.18-A.

.3 The unit manufacturer packaged controls shall operate the unit fan speed control.

.4 The packaged controls shall operate the fan speed as required to optimize the operation for cooling, heating.

.10 Cooling

.1 On a rise in space temperature above set point, energize the supply fan and the DX coil/ condensing unit.

.2 On a fall in space temperature above set point, de-energize the DX coil/ condensing unit and supply fan.

.11 Heating

.1 On a fall in space temperature below set point, energize the supply fan and electric heat or heatpump cycle or,

.1 Enable the independent electrical unit heater.

.2 On a rise in space temperature above set point, de-energize the and electric heat or heatpump cycle and supply fan or

.1 Disable the independent electrical unit heater.

.12 Deadband

.1 Provide adequate deadband to prevent short cycling of the unit.

.13 Loss of power

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

.14 Alarms and events

.1 The unit packaged control system shall process all alarms and events as programmed within the manufacturer's control system.

.2 Space/zone temperature alarm

.3 High-temperature alarm as sensed by the space air temperature sensor

.1 level 3 alarm: if the space/zone is 5°F above cooling upper limit setpoint for 10 minutes, generate a level 3 alarm at the BMS & graphic user interface.

.2 level 2 alarm: if the space/zone is 15°F above cooling upper limit setpoint for 10 minutes, generate a level 2 alarm at the BMS & graphic user interface.

.4 Low-temperature alarm as sensed by the space air temperature sensor

.1 level 3 alarm: if the space/zone is 5°F below heating lower limit setpoint for 10 minutes, generate a level 3 alarm at the BMS & graphic user interface.

.2 level 2 alarm: if the space/zone is 15°F below heating lower limit setpoint for 10 minutes, generate a level 2 alarm at the BMS & graphic user interface.

.15 Damper position alarms

.1 All dampers shall be provided with position indication.

.2 Level 2 alarm: upon a signal to open the isolation damper, if the position switch does not activate within the installed damper actuator motor drive run time + 10 seconds; generate an alarm

.16 Variable frequency drive fault alarm

.1 Faults generated by an associated variable frequency drive; the unit shall de-energize associated fan(s).

.2 Level 2 alarm: upon report of a fault

.3 Deenergize the associated fan(s).

.4 For multiple supply, multiple return/exhaust fan unit only: The unit shall remain in operation with the remaining fan(s) that are operable.

.5 Alarm shall be provided.

.17 Fire Alarm:

.1 Fire alarm indication shall be provided

.2 Level 1 alarm: upon activation of the fire alarm signal;

.3 Deenergize the fan(s) and AC units

.4 Dampers shall return to their fail-safe positions

.5 A signal shall also be sent to the fire alarm control panel

.6 Alarm shall be provided.

.18 Unit general fault alarm

.1 Level 2 alarm: if the unit signals a general fault; generate a level 2 alarm at the BMS & graphic user interface.

.19 Loss if power

.1 Level 2 alarm: if the unit signal a loss of power alarm; generate a level 2 alarm at the BMS & graphic user interface.

.20 BMS disconnection alarm

.1 Level 3 alarm: if the BMS signals connection has been lost between the building control system and the packaged unit controls system; generate a level 3 alarm at the BMS & graphic user interface.

.21 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.24 AIR CONDITIONING (IT/ COMM ROOMS):

.1 General

.1 Units shall operate intermittently as required to maintain space temperature and indirectly humidity conditions.

.2 Provide all interface, wiring, relays, interlocks, controls, and programming as required for interfacing and operation of the AC units pre-packaged control system.

.2 Unit shall generally consist of the following:

.1 Supply fan(s) with speed control.

.2 DX refrigerant coil with remote outdoor condensing unit.

.3 Heating by electric heating coil or heatpump operation, or independent electrical unit heater.

.4 Filter section.

.5 All required sensors and transmitters.

.6 Pre-packaged control system.

.3 The air-conditionings unit shall have the following hardwired connections:

.1 BACNET MS/TP network interface or BACNET ethernet network interface for monitoring unit operation and performance.

.4 The BMS shall monitor temperatures and setpoints

.5 If communication is lost with the BMS, the unit controller shall operate using its last communicated setpoints and run command and an alarm shall be generated.

.6 Scheduling

.1 unit's system shall be scheduled and enabled to operate continuously (24 hours per day).

.7 Space conditioning setpoints

.1 Temperature setpoint: 78°F ±5°F

.2 Temperature deadband: 4°F

.3 Humidity: 45% +5% (indirectly by cooling mode)

.8 Startup / shutdown

.1 Startup and shutdown shall be sequenced by the BAS through the unit manufacturer packaged control system.

.2 Redundancy: Rooms that are equipped with multiple air conditioning units have built in 50 to 70% redundancy, therefore:

.1 Enable the duty unit/s first

.2 If space temperature is not satisfied after 15 minutes, enable the other standby units to start.

.3 Rotate duty standby units every month (operator adjustable).

.9 Fan operation

.1 The unit manufacturer packaged controls shall operate the unit fan speed control.

.2 The packaged controls shall operate the fan speed as required to optimize the operation for cooling, heating.

.10 Cooling

.1 On a rise in space temperature above set point, energize the supply fan and the DX coil/ condensing unit.

.2 On a fall in space temperature above set point, de-energize the DX coil/ condensing unit and supply fan.

.11 Heating

.1 On a fall in space temperature below set point, energize the supply fan and electric heat or heatpump cycle or,

.1 Enable the independent electrical unit heater.

.2 On a rise in space temperature above set point, de-energize the and electric heat or heatpump cycle and supply fan or

.1 Disable the independent electrical unit heater.

.12 Deadband

.1 Provide adequate deadband to prevent short cycling of the unit.

.13 Loss of power

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

.14 Alarms and events

.1 The unit packaged control system shall process all alarms and events as programmed within the manufacturer's control system.

.2 Space/zone temperature alarm

.3 High-temperature alarm as sensed by the space air temperature sensor

.1 level 3 alarm: if the space/zone is 5°F above cooling upper limit setpoint for 10 minutes, generate a level 3 alarm at the BMS & graphic user interface.

.2 level 2 alarm: if the space/zone is 15°F above cooling upper limit setpoint for 10 minutes, generate a level 2 alarm at the BMS & graphic user interface.

.4 Low-temperature alarm as sensed by the space air temperature sensor

.1 level 3 alarm: if the space/zone is 5°F below heating lower limit setpoint for 10 minutes, generate a level 3 alarm at the BMS & graphic user interface.

.2 level 2 alarm: if the space/zone is 15°F below heating lower limit setpoint for 10 minutes, generate a level 2 alarm at the BMS & graphic user interface.

.15 Fire Alarm:

.1 Fire alarm indication shall be provided

.2 Level 1 alarm: upon activation of the fire alarm signal;

.3 Deenergize the fan(s) and AC units

.4 Dampers shall return to their fail-safe positions

.5 A signal shall also be sent to the fire alarm control panel

.6 Alarm shall be provided.

.16 Unit general fault alarm

.1 Level 2 alarm: if the unit signals a general fault; generate a level 2 alarm at the BMS & graphic user interface.

.17 Loss if power

.1 Level 2 alarm: if the unit signal a loss of power alarm; generate a level 2 alarm at the BMS & graphic user interface.

.18 BMS disconnection alarm

.1 Level 3 alarm: if the BMS signals connection has been lost between the building control system and the packaged unit controls system; generate a level 3 alarm at the BMS & graphic user interface.

.19 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.25 CABINET, FORCED FLOW AND UNIT HEATER CONTROL

.1 General:

.1 The heater shall operate intermittently as required to maintain space temperature.

.2 Controls described herein shall be performed by the unit mounted controller using electric actuation and either PI or PID control logic. PI or PID control shall be determined by the applications ability for control tuning. Provide all interface, wiring, relays, interlocks, controls, and programming as required for operation.

.2 The heater shall generally consist of the following:

.1 Supply fan.

.2 Heating water coil and control valve

.3 Air filter (cabinet, forced flow).

.4 All required sensors and transmitters.

.5 Multi speed Motor Starter

.6 Thermostat / controller

.3 Building management system (BMS) interface:

.1 The BAS shall monitor temperatures and setpoints from the cabinet unit heater controller.

.2 If communication is lost with the BMS, the unit controller shall operate using its last communicated setpoints and run command and an alarm shall be generated.

.4 Scheduling:

.1 The heaters shall be programmed to be capable of operating in two occupancy modes. The occupancy mode shall be determined through a user-adjusted, graphical, seven-day schedule with a holiday schedule.

.2 The occupancy modes are described as follows:

.1 Occupied: all heaters shall be programmed to operate in the occupied mode continuously (24 hours per day).

.2 Unoccupied: an optional unoccupied mode shall be made available to the users within the building management system

.5 Space temperature setpoints:

.1 During occupied mode, maintain the following heating space temperature conditions:

.1 Stairwells: pace temperature set point of 68°F, adjustable.

.2 Vestibules: space temperature set point of 68°F, adjustable

.3 Other areas: operator selected

.6 Fan start/stop control:

.1 On call to run for heating, energize the cabinet unit heater fan to run.

.2 Simultaneously, the heating water control valve shall modulate open

.3 Once space temperature has been satisfied; the fan shall be de-energized, and the heating water control valve shall modulate closed.

.7 Fan minimum "On/Off":

.1 The supply fan shall have a minimum time setting for fan "On" and fan "Off" to prevent short cycling the fan operation.

.2 Provide adequate deadband to reduce cycling of fan operation.

.8 Heating:

.1 On a fall in space temperature below set point, modulate the heating water control valve towards the open position.

.2 On a rise in space temperature, modulate the heating water control valve towards the closed position.

.9 Alarms

.1 Unit heater fan failure alarm:

.1 Level 2 alarm: on failure to run, disable the unit heater fan and send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.2 Space/zone temperature alarm:

.3 Low-temperature alarm

.1 level 3 alarm: if the space/zone is 10°F below heating lower limit setpoint for 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.2 level 2 alarm: if the space/zone is 20°F below heating lower limit setpoint for 10 minutes, generate a level 2 alarm at the BAS & graphic user interface.

.3 Low-temperature alarms shall be suppressed in the following conditions:

.1 heating system status of 'Systemok' is reported as 'False'

.2 BMS disconnection alarm

.10 Loss of power:

.1 The cabinet unit heater shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.26 VAV TERMINAL UNIT WITH REHEAT AND PERIMETER HEAT

.1 General description:

.1 pressure independent through its operating range. Control to maintain zone temperature.

.2 Scheduling:

.1 Refer to the 'Zone Group Description Table' and/or associated air handling units for operation schedule information.

.2 Terminal unit shall operate occupied or unoccupied mode based on time of day scheduling.

.3 Space setpoints:

.1 During occupied mode, morning warm-up, or morning cool-down mode, maintain the following space temperature conditions and minimum space airflow setpoint:

.1 Cooling: Space temperature set point of 75°F.

.2 Heating: Space temperature set point of 72°F.

.2 During unoccupied mode, maintain the following space temperature conditions and minimum airflow setpoint.

.1 Cooling: Space temperature set point of 80°F.

.2 Heating: Space temperature set point of 68°F.

.4 Airflow setpoints:

.1 During the occupied mode; the terminal unit airflow shall be allowed to modulate between the scheduled minimum and cooling/heating maximum airflows.

.2 During the unoccupied mode; the terminal unit airflow shall be allowed to modulate between zero airflow (shutoff) and cooling /heating maximum airflows.

.5 Terminal unit control logic

.1 Terminal units and AHU interconnected through BMS system. All terminal units' parameters are monitored and through algorithm all terminal units and AHU settings are controlled to ensure most efficient operation while satisfying all spaces.

.2 Cooling:

.1 On a rise in space temperature above set point, modulate the damper towards the open position (reset airflow set point towards maximum cooling airflow set point).

.2 On a fall in space temperature below set point, modulate the damper towards the closed position (reset airflow set point towards minimum airflow set point).

.3 If supply air temperature from the air handling unit is greater than the room temperature; BMS shall reset air handling unit discharge temperature.

.3 Deadband: when the space temperature is in the deadband range; the airflow shall be maintained at the minimum allowable airflow.

.4 Heating:

.1 On a drop in space temperature; the air flow shall be reduced to minimum setting; supplemental heating water control valve shall modulate open raising the discharge air temperature (DAT).

.2 The discharge air temperature (DAT) shall continue to rise until the maximum discharge air temperature.

.3 Once the discharge air temperature (DAT) has reached its maximum allowable setpoint and there is a continued drop in space temperature; the airflow damper shall modulate towards the open position (reset airflow set point towards maximum heating airflow set point). The heating water control valve shall modulate to maintain the maximum DAT during this stage of heating.

.4 On a drop in space temperature; reverse the sequence.

.5 Heating with perimeter / radiant heat:

.1 On a drop in space temperature; the heating water control valve shall modulate open raising the discharge air temperature (DAT) to the space setpoint.

.2 Once the DAT reaches the space setpoint temperature, the perimeter heating valve shall modulate open.

.3 Once the perimeter heating valve reaches 100% open, the discharge air temperature (DAT) shall continue to rise until the maximum discharge air temperature.

.4 Once the discharge air temperature (DAT) has reached its maximum allowable setpoint and there is a continued drop in space temperature; the airflow damper shall modulate towards the open position (reset airflow set point towards maximum heating airflow set point). The heating water control valve shall modulate to maintain the maximum DAT during this stage of heating. On a drop in space temperature; reverse the sequence.

.6 Space temperature set point & mode adjustment:

.1 Allow set point adjustment at space temperature sensor and limit adjustment to ± 3°F.

.2 Unoccupied mode override push button: upon activation of the space sensor unoccupied mode override push button, operate occupied and disable demand controlled ventilation for 60 minutes.

.7 Demand controlled ventilation:

.1 In occupied mode, the CO^2 control loop shall reset the airflow set point from the terminal unit occupied minimum airflow set point up to the maximum occupied airflow setpoint. Refer also to AHU CO^2 system control requirements.

.8 Alarms

.1 Low airflow alarm

.1 Level 3 alarm: if the measured airflow is less than 70% (adjustable)of setpoint for 5 minutes while the setpoint is greater than zero (0), generate a level 3 alarm at the bas & graphic user interface.

.2 Level 2 alarm: if the measured airflow is less than 50% of setpoint for 5 minutes while the setpoint is greater than zero (0), generate a level 2 alarm at the bas & graphic user interface.

.3 Alarm suppression: if the zone has an importance-multiplier of 0 for its static pressure reset trim & respond control loop, low airflow alarms shall be suppressed for that zone.

.2 Airflow sensor calibration alarm

.1 Level 4 alarm: If the fan serving the zone has been 'Off' for 10 minutes, and the airflow sensor reading is above 10% of the cooling maximum airflow set point, generate a level 4 alarm at the BAS & graphic user interface.

.3 Leaking damper alarm

.1 Level 4 alarm: If the damper position is 0%, and airflow sensor reading is above 10% of the cooling maximum airflow setpoint for 10 minutes while the fan serving the zone is proven 'On', generate a level 4 alarm at the BAS & graphic user interface.

.4 Leaking valve alarm

.1 Level 4 alarm: If the valve position is 0% for 15 minutes, and discharge air temperature is above the ahu supply air temperature by 5°F, and the fan serving the zone is proven 'On', generate a level 4 alarm at the BAS & graphic user interface.

.5 Space/zone temperature alarm

.1 High-temperature alarm

.1 Level 3 alarm: If the space/zone is 3°F above cooling setpoint for 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.2 Level 2 alarm: If the space/zone is 5°F above cooling setpoint for 10 minutes, generate a level 2 alarm at the BAS & graphic user interface.

.2 Low-temperature alarm

.1 Level 3 alarm: if the space/zone is 3°f below heating setpoint for 10 minutes, generate a level 3 alarm at the bas & graphic user interface.

.2 Level 2 alarm: if the space/zone is 5°f below heating setpoint for 10 minutes, generate a level 2 alarm at the bas & graphic user interface.

.3 High-temperature and low-temperature alarms shall be suppressed in the following conditions:

.1 Heating or cooling system status of 'Systemok' is reported as 'False'

.2 While the zone group is in 'warm-up' or 'cooldown' modes

.6 CO^2 sensor alarms

.1 If the CO^2 concentration exceeds setpoint plus 10% for more than 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.2 If the CO^2 concentration is less than 300 ppm, or the zone is in unoccupied mode for more than 2 hours and the zone CO^2 concentration exceeds 600 ppm, generate a level 3 alarm at the BAS & graphic user interface. The alarm text shall identify the sensor and indicate that it may be out of calibration.

.9 Testing/commissioning overrides

.1 Provide software switches that interlock to a system level point to perform the following:

.1 Force zone airflow setpoint to 'Zero (O)'

.2 Force zone airflow setpoint to 'Zone Maximum Cooling Airflow Setpoint'

.3 Force zone airflow setpoint to 'Zone Minimum Airflow Setpoint'

.4 Force zone airflow setpoint to 'Zone Maximum Heating Airflow Setpoint'

.5 Force damper full closed/open

.6 Force heating to off/closed

.7 Reset request-hours accumulator point to zero (trim and respond control logic

.1 Provide one point for each type of system request

.10 Requests / resets

.1 Static pressure reset

.1 Terminal unit shall send all required requests made for trim & respond logic static pressure reset control.

.1 If measured airflow < 50% of setpoint, while the setpoint is greater than Zero (0) and the damper position is greater than 95% for 1 minute, send 3 requests.

.2 Else, if the measured airflow < 70% of setpoint, while the setpoint is greater than zero (0) and the damper position is greater than 95% for 1 minute, send 2 requests.

.3 Else, if the damper position > 95%, send 1 request until the damper position is less than 85%.

.4 Else, if the damper position is <95%, send 0 requests.

.2 Terminal unit shall send all required position feedback for critical zone PID control logic static pressure reset control.

.2 Heating hot water system pressure reset

.1 Terminal unit shall send all required requests made for trim & respond logic heating hot-water system pressure reset control.

.1 If the HW valve position > 95%, send 1 request until the HW valve position is less than 10%.

.2 Else, if the HW valve position < 10%, send 0 requests.

.2 Terminal unit shall send all required position feedback for critical zone PID control logic heating hot-water system pressure reset control.

.11 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.27 CHILLER PLANT - AIR SOURCE HEAT PUMPS (ASHP):

.1 The chillers depicted herein and in mechanical schedules are Air Source Heat Pumps that can produce chilled and / and/or hot water.

.2 General:

.1 The chilled glycol system consists of the following major pieces of equipment:

.1 Chillers (ASHP)

.1 Each chiller has 9 independent modules.

.2 variable primary chilled glycol pumps

.2 Chillers/ modules are intended to operate as an n+1 plant configuration during times when the airside equipment throughout the facility is not operating in air-side economizing modes.

.3 The chillers/ modules operate as a lead / lag / standby configuration to maintain leaving chilled glycol temperature.

.4 Primary chilled glycol pumps

.1 these pumps are operated when the chiller system is in operation.

.2 the chilled glycol pumping system uses a variable primary pumping arrangement

.3 these pumps operate to maintain chiller/ modules differential pressure setpoint.

.3 Controls description

.1 The chilled glycol system shall be controlled automatically through a local DDC panel, packaged chiller controls, and pump VFD using PI and PID control logic.

.2 Sensing and valve elements shall be electronic type.

.3 Safety and limit controls are part of the chiller control panel.

.4 Other operating limitations and alarms are described within this sequence of operation and manufacturer's equipment requirements.

.4 Control components include (but are not limited to) the following:

.1 differential pressure sensors / transmitters to track / control flow across the chiller/ module's evaporator and condenser barrels

.2 control valves / actuators / transmitters to modulate flow through chillers/ modules, coils, system bypasses, drains, etc.

.3 flow meters to record system flows and system load / energy use.

.4 differential pressure sensors / transmitters to modulate flow through variable speed pumps

.5 Communications and all available control points shall be taken from the chiller control panels through a network software connection.

.5 Chiller/ module - building management system (BMS) interface

.1 The building management system will monitor the status of all chillers/ modules to determine the chiller's availability to operate and serve the load of the facility.

.2 Review the chiller manufacturer operating status conditions to differentiate between status reports that indicate that a chiller is operating or return to operation and status conditions that indicate the chiller will not come back online without manual corrective action due to a latching alarm.

.3 When a latching alarm occurs; the chiller/ module shall be disabled and alarmed.

.4 When a chiller/ module is not enabled or is in a latching alarm condition, the chilled glycol valves shall be closed.

.6 The building control system shall obtain the following, but not limited to, control points from the chiller's/ module control panel (BACnet) and/ or from a chiller interface panel and/ or form the multi-chiller panel.

.1 leaving chilled glycol temperature

.2 entering chilled glycol temperature

.3 evaporator refrigerant pressure

.4 compressor discharge refrigerant pressure

.5 evaporator refrigerant temperature

.6 oil temperature

.7 oil pressure differential

.8 chiller status

.9 evaporator fluid pressure drops

.10 evaporator flow status

.11 manual reset alarm (each alarm identified)

.12 automatic reset alarm (each alarm identified)

.13 communication state

.14 chiller enable / disable

.15 chilled glycol supply temperature setpoint

.16 current limit setpoint

.17 compressor kw

.18 defrost mode status

.19 COP

.7 If the points listed above are not available through the chiller control panel interface, they shall be provided by the control's contractor through a separate interface panel or hard-wired connections.

.8 The building control system shall obtain ALL control points from the chiller's control panel (BACnet) and/or from the multi - chiller interface panel.

.9 All points available from the chiller, through an interface panel, or directly from the chiller controller, whether listed above or not, shall be brought into a detailed, graphical chiller control and status screen.

.10 Some points are to be shown as "indication/ monitoring points" only.

.11 Chiller/ moldule load shall be received from the chiller control panel and/or calculated from control devices.

.12 Provide a maintenance toggle switch at each chiller/ module which will make the chiller unavailable to the control system. This will allow the chiller to start manually without effecting operation of controls.

.13 Scheduling

.1 The chiller/ module plant shall be available continuously (24/7) to provide chilled glycol (or hot heating glycol) to the facility and /or by Operator selectable Schedule.

.14 Plant system enable / disable

.1 The chiller/ module plant system controls shall be activated by a single enable setpoint.

.2 A "system enable" mode, all chillers, chiller plant (primary) pump sequences and chilled glycol components (secondary) shall be activated and made available for operation.

.15 In "system disable" mode, all chillers/ modules, chiller plant pump sequences, chilled glycol components, shall be deactivated and not made available for operation.

.16 Information from the chiller plant control system (status, alarms, etc.) Shall be used to determine the "systemok" status. Refer to the "status - systemok general notes". "systemok" status shall be used to determine various allowable alarm suppressions within the BMS.

.17 Chilled glycol plant modes of operation & startup

.1 Manual

.1 Chillers, pumps, and other components shall be capable of manually being enabled / disabled and pump speed/ flow controlled.

.2 Automatic

.1 Normal operation:

.2 the BMS shall incorporate separate modes of operation to achieve chilled glycol temperature setpoint based on outside air conditions and equipment demand.

.3 Automatic flow control

.18 Initial plant startup:

.1 during initial chiller/ module plant startup, the following shall determine the equipment sequence to bring the chiller/ module plant online:

.1 if OAT > 52°F (adjustable); chiller enable = "yes"

.2 elseif oat ≤ 52°F (adjustable); chiller enable = "no"

.3 endif

.2 if the chiller plant/ module cooldown loop sequence is not initiated; after 15 minutes (adjustable), the chiller/ module plant shall enter normal operation.

.19 Chiller/ module enable / disable / alarm

.1 The local BMS control panel shall provide a chiller/ module enable and chiller/ module disable signal to the chillers/ module based on chiller/ module plant sequencing controls

.1 "chiller/ module enable" shall allow the packaged chiller to operate under its own control

.2 "chiller/ module disable" shall prevent the chiller from operating.

.20 Alarms

.1 if an enabled chiller/ module fails to start after a 3-minute time delay, or the chiller returns a latching alarm signal, the next chiller in sequence shall be enabled, the alarmed chiller's status changed to "alarm" and that chiller shall be disabled.

.2 the indication that the chiller/ module has started shall be the chiller status signal from the BACnet interface indicating that the chiller is "running" or "loading". If the chiller is waiting for flow signals at the end of the time delay, this is an indication that there are problems with valves, pumps, or the chiller/ module; and the next chiller/ module in the start order shall be brought online and an alarm shall be initiated.

.3 latching alarms are identified by the manufacturer and require manual reset. The system can be restored by manually updating the chiller/ module status, after the alarm is cleared.

.4 when a single chiller/ module is not enabled or is in a latching alarm conditions, close the chiller/ module water control valve.

.5 non-latching alarms are items caused by things such as the time delay allows for pumps to ramp up to speed and valves to open. If after the time delay, the equipment still does not start, the alarm indicated something is wrong and the BMS treats the non-latching alarm as a latching alarm which must be manually reset.

.21 Chiller (ASHP) sequencing and control:

.1 General

.1 Packaged chiller/ module controls on each chiller/ module (Note: each chiller has 9 individual modules that can be controlled independently in cooling or heating mode) shall cycle efficiently maintain the chilled glycol supply temperature at the respective chilled glycol temperature setpoint. Each chiller's/ module chilled glycol supply temperature shall be independently set.

.2 Order of operation

.1 The actual order of operation is the order the BMS uses to determine which chiller/ module is started or stopped next. Actual order shall be based on the order of priority. The order of priority shall be as follows:

.1 operator override.

.2 run hours.

.2 On the chilled/ module glycol system control screen (or sub-screen), create a schedule showing the order of chiller operation. The schedule shall include the following fields:

.1 chiller - each line will display the chiller/ module tag identification. (i.e. ch-1, ch-2…to 18).

.2 actual order of operation - each line will display the order the BMS uses to determine which chiller/ module is started or stopped next. (i.e. 1, 2 … to 18)

.3 operator override order - this field is the only line the operator can enter values into the table. (i.e. 1, 2 … to 18)

.4 changes are updated when the operator selects the button to update the table.

.5 if the sum of the order of operation entered by the operator is not equal to 18 (18 chiller/ module systems); the operator override is rejected, the entered values are cleared, and an error message is displayed indicating, "not every chiller/ module is accounted for, re-enter operator override order".

.6 if the sum of the order of operation entered by the operator is equal to 18; the operator override is accepted. If the override results in starting a new chiller/ module that is not currently in operation; the new chiller shall be started before shutting down the operating chiller/ module.

.7 run hour order - this field is determined by the BMS in order to operate the chiller/ module with the least run hours first. Chiller/ module run order is predetermined at the same time every week. The adjustable default time for the BMS to determine the weekly run order shall be 8am each Thursday.

.8 run hours - this field displays the run hours that are calculated and tracked by the BMS as cumulative hours of operation since the initial start-up.

.9 status - this field shall display the status of each chiller (i.e. run / off / alarm).

.10 if the chiller/ module status is indicated as "alarm", the BMS shall consider the chiller not available, and the next chiller/ module in order will be started. When the alarm is cleared, the operator can select "update table" to reset the chiller status.

.11 chiller load/ module - this field shall display the chiller load that is signaled from the chiller/ module and/or calculated as described in the chiller/ module load calculations section. The load shall be reported in percentage (0% - 100%).

.12 operating kw - this field shall display the chiller/ module operating power that is signaled from the chiller control panel.

.13 if operating kw is not directly available, the chiller/ module power shall be calculated from amperage data from the chiller control panel as follows: kw = voltage x chiller amperage x 1.732 x power factor.

.22 Initial chiller startup

.1 When the first (lead) chiller/ module receives a "chiller/ module enable" signal, the chiller control panel shall send a signal to the BMS to start a chilled glycol pump (if not already in operation) and condenser water pump.

.2 this signal is sent to the BMS, not directly to the pumps.

.3 the BMS shall start the next respective pumps identified to operate and simultaneously open the chiller's chilled glycol isolation valves as described in the pump control sequences.

.4 Once proof of flow safeties are verified at the chiller's/ module chilled glycol flow switches, the chiller/ module will be energized and start / operate under the control of their own packaged chiller/ module control system to maintain chilled glycol supply temperature at the chilled glycol setpoint signaled by the BMS.

.5 initial chilled glycol setpoint = temperature as determined by the chilled glycol reset schedule.

.23 Starting the next chiller/ module

.1 The second (lag) chiller/ module shall be energized and brought online when any of the following conditions occur after the lead chiller has been running for a duration minutes > 30 minutes (adjustable):

.1 lead chiller/ module power kw > 85% rating.

.2 lead chiller/ module chilled glycol flow gpm > 90% capacity.

.3 Temperature chws °F > 2°f above setpoint for a time seconds > 120 seconds.

.4 timer is reset each time the load deviates from setpoint criteria.

.2 The second (lag) chiller/ module startup sequence shall be like the first (lead) Chiller/ module sequence.

.3 When starting the second (lag) chiller/ module, the chilled glycol isolation valves shall open and modulate to maintain flow minimums for both operating chillers/ modules.

.4 the isolation valves shall be opened slowly over a prescribed and tuned period of time for stable operation of the chiller/ module systems.

.24 Shutting down (de-energizing) chillers

.1 The system shall calculate a comparison value for what the maximum load of the proposed remaining chiller(s) / modules can accommodate. The second (lag) chiller/ modules shall be disabled whenever the real-time calculated chilled glycol load is less than 90% if the proposed remaining chiller plant capacity for a duration minutes > 30 minutes.

.2 the real-time calculated chilled glycol load to determine a chiller shutdown shall be the higher of the two loads reported below:

.1 sum of reported chiller loads/ modules from the chiller multi control panel/s.

.2 sum of calculated load at the chiller(s) using flow and temperature data.

.3 the chiller shutdown timer is reset each time the load rises above 90% of the remaining chiller/ modules capacity.

.3 When shutting down the second (lag) chiller/ modules, the chilled glycol isolation valves shall close and modulate to maintain flow minimums for the operating chiller(s) / modules.

.4 When the BMS signals to shut down the first (lead) chiller/ modules, the shutdown shall occur like the lag chiller/ modules.

.5 The minimum runtime for a chiller shall be 30 minutes (adjustable).

.25 Chilled glycol pump control (primary)

.1 General

.1 The chilled glycol pump system will operate by signals received from the BMS.

.2 Enable / disable (initial startup & chiller mode switchover)

.3 The BMS shall send a signal to enable the chilled glycol pump(s).

.4 Chiller(s) / modules enabled:

.1 upon a signal from the BMS to start a pump and when "chiller enable" = 1; energize the lead chilled/ modules glycol pump.

.2 pump starting order shall be determined by the BMS.

.3 simultaneously open the chiller's chilled glycol isolation valve that is associated with the enabled chiller/ modules.

.4 while "chiller enabled" = 1; modulate the chilled glycol flow to maintain the chilled glycol system flow 10% above the minimum required flow rate for a chiller/ modules or single pump to operate.

.5 System differential pressure transmitters

.1 Differential pressure transmitters in chilled glycol chillers shall provide a signal for pump speed control.

.2 Each sensor shall have an independent setpoint based on the chiller pressure drop requirements. Actual setpoint shall be optimized by the tab contractor and field verified by the commissioning agent.

.3 The controlling differential sensor/transmitter shall be the one with the greatest error signal.

.4 The other differential sensors/transmitters shall be active and report a signal to the BMS, but only the controlling differential sensor/transmitter in correlation with the chilled glycol system flow measurement and chillers water flow requirements shall provide the control signal for the pump(s) speed.

.26 Order of operation

.1 The actual order of operation is the order the BMS uses to determine which chiller/ module and associated pump is started or stopped next. Actual order shall be based on the order of priority. The order of priority shall be as follows:

.1 operator override.

.2 run hours.

.27 On the chilled glycol system control screen create a schedule showing the order of chilled glycol pump operation. The schedule shall include the following fields:

.1 chilled glycol pump - each line will display the chilled glycol pump tag identification.

.2 actual order of operation - each line will display the order the BMS uses to determine which pumps is started or stopped next. (i.e. 1, 2 … etc).

.3 operator override order - this field is the only line the operator can enter values into the table. (i.e. 1, 2 … etc).

.4 changes are updated when the operator selects the button to update the table.

.5 if the sum of the order of operation entered by the operator is not equal to 2; the operator override is rejected, the entered values are cleared, and an error message is displayed indicating, "not every pump is accounted for, re-enter operator override order".

.6 if the sum of the order of operation entered by the operator is equal to 2; the operator override is accepted. If the override results in starting a new pump that is not currently in operation; the new pump shall be started before shutting down the operating pump.

.7 run hour order - this field is determined by the BMS in order to operate the pump with the least run hours first. Pump run order is predetermined at the same time every week. The adjustable default time for the BMS to determine the weekly run order shall be 8am each Thursday.

.8 run hours - this field displays the run hours that are calculated and tracked by the BMS as cumulative hours of operation since the initial start-up.

.9 status - this field shall display the status of each pump (i.e. run / off / alarm).

.10 if the pump status is indicated as "alarm", the BMS shall consider the pump not available, and the next pump in order will be started. When the alarm is cleared, the operator can select "update table" to reset the pump status.

.11 pump speed - this field shall display the pump speed that is signaled from the pump VFD. The speed shall be reported in percentage (0% - 100%).

.12 operating kw - this field shall display the pump operating power that is signaled from the pump VFD.

.28 Chilled glycol pump control logic

.1 General

.1 an additional pump is started automatically when starting a second chiller

.2 an additional pump shall be started if required to satisfy differential pressure setpoints noted above.

.29 System differential pressure (dp)

.1 if "dpsensor" < "dpsetpoint; increase pump speed.

.2 elseif "dpsensor" > "dpsetpoint; decrease pump speed.

.3 endif.

.30 Operational range

.1 the pump(s) shall be soft started from off and operate from 25% - 100% speed via the variable frequency drive(s) to maintain the differential pressure setpoint. VFD's shall not operate below 15hz.

.31 Hydraulic Bridge (low loss header) reset option.

.1 Hydraulic Bridge (low loss header) flow on both primary and secondary water loops have an influence on overall system performance and temperature stability.

.2 The system is designed to operate with similar flows on primary and secondary loops, otherwise the temperatures on each loop will differ significantly.

.3 If significant difference in temperature of primary and secondary loops are observed over a period of 30 min (adjustable) reset pump flow and enable more chillers/ modules gradually to equalize flow and also maintain design temperatures. The control contractor shall make necessary setpoint adjustments to tune the sequence in the field.

.32 Pump failure / fault

.1 If either pump fails to start or issues an alarm due to a fault; the failed pump shall be locked out of operation and the other pump shall be started.

.33 Chiller evaporator modulating control valve

.1 The chiller evaporator control valve shall modulate to establish and control chilled glycol flow through chillers to perform the following tasks:

.1 Start and stop chillers/ modules.

.2 Control load of individual chillers/ modules.

.3 Maintain evaporator flow within design limits.

.2 Starting and stopping chillers

.1 Chilled glycol control valves shall

.1 stroke from fully open to fully closed over a 60 second (adjustable) period. Stroke time shall be adjusted during chiller/ module startup testing to ensure stable operation.

.2 open any time a chiller/ module is called to start, and open prior to the chiller/ module being enabled.

.3 closed any time a chiller/ module is called to stop and closed after the chiller/ module is disabled.

.3 On a call for chiller/ module operation; the multi chiller/ module control panel shall signal the BMS for chilled glycol pump operation and the BMS shall additionally throttle open the chiller evaporator control valve.

.4 If the chiller/ module is the first (lead) chiller/ module to be started:

.1 open the evaporator control valve.

.5 If the chiller/ module is the second (lag) chiller/ module to be started:

.1 open the evaporator valve to the position where the measured flow for the respective shell exceeds the minimum flow by 10% and hold the position during startup.

.2 once startup is completed, the chiller/ module evaporator control valve shall operate to control chiller/ module load.

.34 Controlling load of chillers

.1 When the chillers are producing chilled glycol within 2°f of setpoint, the evaporator control valves shall be released to allow modulation to maintain load at the setpoint.

.2 The controller shall modulate the chilled glycol control valves to balance chilled glycol flow through the chiller/ module evaporators.

.3 the differential pressure setpoint (chiller flow) shall be re-evaluated on a schedule every 10-30 minutes. Once the chiller/ module load is established, the valve shall be held in this position until the next evaluation period. This will prevent the valve from continuously hunting and ensure load fluctuations between updates are distributed proportionally across the operating chillers/ module.

.35 Maintaining evaporator flow within the design limits

.1 The chiller evaporator valves shall control to help ensure a chiller/ module:

.1 meets the minimum flow requirements.

.2 does not exceed maximum flow limitations.

.36 Minimum flow requirements

.1 refer to evaporator valve operation for starting and stopping chillers/ modules.

.2 Refer to manufacturer recommendations.

.37 Maximum flow limitations

.1 Chillers/ modules shall not be allowed to exceed 95% (adjustable) of the design flow rate.

.2 Refer to manufacturer recommendations.

.38 Chiller/ module plant system resets

.1 Chilled glycol temperature reset

.1 The BMS shall incorporate leaving chilled glycol setpoint setback based on outside air temperature.

.2 Chilled glycol setback shall be in the range of: 42°F to 48°F

.3 The chilled glycol setpoint setback shall be linear between 42°F to 48°F when outdoor temperature is between 80°F to 50°F (operator adjustable)

.2 The operator shall have the ability to manually reset the leaving chilled glycol setpoint and override the chilled glycol setpoint that has been determined by the BMS control.

.3 Chilled glycol setpoint selection priority shall be as follows

.1 setpoint by operator override

.2 setpoint determined by chilled glycol reset schedule/ outdoor temperature or system demand.

.39 Chiller flow & differential pressure

.1 Chiller flow signals shall be calculated from the chiller shell differential pressure, provided as part of the DDC controls.

.2 the chiller manufacturer shall provide equations that shall be used to calculate shell flow as a function of shell differential pressure at all ranges of flow characteristics. Equations above minimum and below minimum chiller flow may differ.

.40 Chiller load calculations

.1 Calculate total system load from the supply and return water temperatures leaving the plant and flow meter downstream of the chilled glycol bypass.

.2 Total load tons = ((tempchwr °f - tempchws °f) x flowgpm) / coefficient.

.3 Each chiller shall likewise be calculated from flow calculations derived using the chiller shell differential pressure as previously described and the entering / leaving chilled glycol temperatures for the chiller.

.41 Chiller plant loop cooldown

.1 A loop cooldown sequence shall be available to prevent a spike in cooling load during times the loop temperature has raised above an acceptable temperature. The cooldown sequence shall be imitated when the chiller/ module plant has been shut down for longer than 4 hours (adjustable) or by a manual override.

.2 In automatic operation:

.1 The cooldown sequence shall operate as follows:

.1 if "system disable" time > 4 hours; enable "cooldown" sequence.

.2 else if "system disable" time < 4 hours; "cooldown" shall not be enabled.

.3 endif

.3 When a cooldown signal is enabled the chiller sequence shall operate as follows:

.1 if "cooldown" is enabled; "chiller/ module enable" signals = 1 for a duration of 60 minutes.

.2 elseif "cooldown" is disabled; "chiller enable" signals may = 1, 2…etc.

.3 endif

.4 When a cooldown signal is enabled the chilled glycol pump sequence shall operate as follows:

.1 if "cooldown" is enabled; "pump enable" signals = 1 for a duration of 60 minutes & a maximum speed of 90%.

.2 else if "cooldown" is disabled; "pump enable" signals may = 1, 2…etc..

.3 endif

.5 In manual operation:

.1 The cooldown sequence shall operate as follows as described in the automatic operation. After a duration of 60 minutes, the manual override "cooldown" signal shall be disabled

.42 Chiller plant loss of power sequence of operation

.1 All BMS control panels shall be connected to an uninterruptible power supply (UPS) to prevent loss of controls when the power is interrupted.

.43 Recovery from power loss

.1 The purpose of this sequence is to bring the cooling plant back online as quickly and smoothly as possible following a power loss.

.2 Indications:

.1 one or more chillers/ modules have tripped out, evidenced by:

.1 chiller/ module enabled; and

.2 momentary power loss or phase loss alarm received from the chiller/ module control panel.

.3 The following conditions will be expected upon restoration of power:

.1 restart of the chillers/ module may take 3-5 minutes.

.2 unless otherwise set by the Operator all equipment will attempt to restart at the same time.

.3 pumps are on variable speed drives and will ramp up to previous operating conditions.

.4 chilled glycol valves open on a non-operating machine puts warm return temperature water into the chilled glycol supply header.

.5 air handling units in the system may or may not have been affected by the power loss.

.4 Upon loss of power (loss of normal power and start of stand-by power system) where chillers/ modules have tripped offline, the following shall be done to mitigate impacts.

.1 plant controls: initiate a 30-minute (adjustable) timer. Adjustable increments shall be made in 15-minute intervals.

.2 chilled glycol pump operate "on" signals shall be maintained at the position at the time of power loss. This allows the system to stagger chiller/ module restarts by disabling and enabling chillers without an extra pumping transient.

.3 do not allow the BMS to recalculate setpoints until the 30 minutes time delay has been completed.

.4 chilled glycol pumps are limited to the speed existing at the time of the power loss. This should not be accomplished by holding the plant leaving chilled glycol differential pressure setpoint during this transient, because opening valves will affect this pressure.

.5 prevent new chillers/ modules from coming online except as outlined below.

.6 chillers operation: chillers shut down due to a power loss shall have their operate signals modified as follows:

.1 lead chiller/ module shall be maintained in the enable mode.

.2 lag chiller/ module, if operating before and is shut down due to power loss, shall be immediately switched to disable mode. Once confirmed restoration of power and after 90 seconds (adjustable), this chiller/ module shall be returned to the enable mode.

.3 standby chiller/ module shall remain in standby mode.

.5 Upon returning to normal power, the chiller/ module plant will experience a second loss of power due to the open transition switch within the auto-transfer switch.

.1 the chiller/ module plant shall be restored to operation as the plant operation in a similar fashion described during the loss of normal power sequence.

1.28 SECONDARY CHILLED GLYCOL PUMP CONTROL (P-05, 06, 07)

.1 General

.1 The Building chilled glycol pump system will operate by signals received from the BMS.

.2 The system shall operate in a duty/ standby pump configuration.

.2 Enable / disable (initial startup)

.1 The BMS shall send a signal to enable the chilled glycol pump(s).

.2 Else; the chilled glycol pumps shall remain disabled.

.3 Upon a signal from the BMS to start a pump;

.1 Start modulation the speed on the first chilled glycol pump. Pump starting order shall be determined by the BMS.

.4 Order of operation

.1 The actual order of operation is the order the BMS uses to determine which pump is started or stopped next. Actual order shall be based on the order of priority. The order of priority shall be as follows:

.1 Operator override.

.2 Run hours.

.3 On the chilled glycol pump system control screen (or sub-screen), create a schedule showing the order of chilled glycol pump operation. The schedule shall include the following fields:

.1 chilled glycol pump - each line will display the chilled glycol pump tag identification.

.2 Actual order of operation - each line will display the order the BMS uses to determine which pumps is started or stopped next. (i.e. 1,2, etc.)

.3 Operator override order - this field is the only line the operator can enter values into the table. (i.e. 1,2, etc.)

.4 Changes are updated when the operator selects the button to update the table.

.5 Run hour order - this field is determined by the BMS in order to operate the pump with the least run hours first. Pump run order is predetermined at the same time every week. The adjustable default time for the BMS to determine the weekly run order shall be 8am each Thursday.

.6 Run hours - this field displays the run hours that are calculated and tracked by the BMS as cumulative hours of operation since the initial start-up.

.7 Status - this field shall display the status of each pump (i.e. Run / Off / Alarm).

.8 If the pump status is indicated as "Alarm", the BMS shall consider the pump not available, and the next pump in order will be started. When the alarm is cleared, the operator can select "Update Table" to reset the pump status.

.9 Pump speed - this field shall display the pump speed that is signaled from the pump VFD. The speed shall be reported in percentage (0% - 100%).

.10 Operating KW - this field shall display the pump operating power that is signaled from the pump VFD.

.5 Operational range

.1 The pumps shall be soft started from off and operate from 25%-100% speed via the variable frequency drives to maintain the differential pressure setpoint. VFD's shall not operate below 15HZ (low limit speed shall be verified by the controls contractor with the installed pump selections surge curve).

.6 Pump failure / fault

.1 If either the pumps fail to start or issues an alarm due to a fault; the failed pump shall be locked out of operation and the redundant pump shall be started.

.2 The original remaining operating pump shall be designated the lead pump and the redundant pump shall become the standby pump.

.7 Pump rotation

.1 If the scheduled pump rotation results in starting a new pump that is not currently in operation; the new pump shall be started before shutting down the operating pump.

.8 Pressure reset

.1 Trim and respond reset (pump differential pressure reset option #1)

.1 Using this option #1, the differential pressure setpoint is reset based on requests made by the chilled glycol system connected to the chilled glycol system.

.2 Differential pressure transmitters in chilled glycol branches provide a signal for pump speed control.

.3 Each sensor shall have an independent setpoint. Actual setpoint shall be optimized by the tab contractor and field verified by the commissioning agent.

.4 The controlling differential sensor/transmitter shall be the one with the greatest error signal.

.5 The other differential sensors/transmitters shall be active and report a signal to the BMS, but only the controlling differential sensor/transmitter shall provide the control signal for the pump(s) speed

.2 Critical zone reset (pump differential pressure reset option #2)

.1 Using this option #2, the differential pressure setpoint is reset based on polling chilled glycol valve position. Chilled glycol valves shall send their position to the pump controller.

.2 Pump differential pressure reset shall be determined as follows:

.3 If 'Any Valve' position > 95%; the differential pressure setpoint shall be increased by 0.1 psi at a frequency of every 5 minutes.

.4 Elseif 'All Valve' positions <90%; the differential pressure setpoint shall be decreased by 0.1 psi at a frequency of every 5 minutes.

.5 Endif

.3 The differential pressure setpoint, reset increment amount, and frequency of reset shall be optimized in the field by the TAB contractor and commissioning agent.

.9 Building Chilled glycol temperature alarm

.1 Temperature alarm as sensed by the building chilled glycol supply/ return temperature sensor

.1 level 3 alarm: if 5°F above or below setpoint for 10 minutes, generate a level 3 alarm at the bas & graphic user interface.

.2 level 2 alarm: if 10°F above or below setpoint for 10 minutes, generate a level 2 alarm at the bas & graphic user interface.

.10 Building Chilled glycol pressure alarm

.1 Pressure alarm as sensed by the building chilled glycol supply/ return pressure sensor

.1 level 3 alarm: if 5 psi above or below setpoint for 10 minutes, generate a level 3 alarm at the bas & graphic user interface.

.2 level 2 alarm: if 10 psi above or below setpoint for 10 minutes, generate a level 2 alarm at the bas & graphic user interface

.11 Variable frequency drive fault alarm

.1 Faults generated by an associated variable frequency drive, de-energize associated pump(s).

.1 Level 2 alarm: upon report of a fault

.1 Deenergize the associated pump(s).

.2 Alarm shall be provided.

.12 Loss of power

.1 Upon loss of power, valves, etc. Shall return to their fail-safe positions.

.2 Upon restoration of power; the pump shall have a delay of 60 seconds prior to restart.

.1 All pumps shall provide a staggered start operation to minimize electrical demand surge during restart.

1.29 HEATING HOT WATER PLANT

.1 General

.1 The heating plant shall operate to maintain heating water supply temperature to the facility.

.2 Several different types of equipment are used to generate heating water for the facility. The equipment within the plant is as follows:

.1 Air Source Heat Pumps (ASHP)

.2 Condensing boilers

.3 the ASHP system is the primary method of generating heating water for the facility for outdoor temperatures as low as -18C (adjustable to minimum -18C or higher temperature). This system shall modulate to meet facility heating water demands during the initial winter season, however will not be sufficient to satisfy the entire facility through the winter season.

.1 The ASHP heating system will be supplemented with hot water generated by condensing boilers.

.2 Below -18C (adjustable to minimum -18C or higher temperature) the ASHP will be disabled, and heating will be provided by the condensing boilers only.

.2 Control components include (but are not limited to) the following:

.1 Control valves / actuators / transmitters to modulate flow through boilers, system bypasses, drains, etc.

.2 Flow meters to record system flows and system load / energy use.

.3 Differential pressure sensors / transmitters to modulate flow through variable speed pumps

.4 Communications and all available control points shall be taken from the boiler control panels through a network software connection.

.3 Boiler - building management system (BMS) interface

.1 The building management system will monitor the status of all boilers to determine the boiler's availability to operate and serve the load of the facility.

.2 Review the boiler manufacturer operating status conditions to differentiate between status reports that indicate that a boiler is operating or return to operation and status conditions that indicate the boiler will not come back online without manual corrective action due to a latching alarm.

.3 When a latching alarm occurs; the boiler shall be disabled and alarmed.

.4 When a boiler is not enabled or is in a latching alarm condition, the boiler water valves shall be closed.

.4 The building control system shall obtain ALL control points from the boiler's control panel (BACnet) and/or from a boiler interface panel.

.5 If additional boiler control points are required in addition to the boiler panel interface, they shall be provided by the control's contractor through a separate interface panel or hard-wired connections.

.6 All points available from the boiler, through an interface panel, or directly from the boiler controller, whether listed above or not, shall be brought into a detailed, graphical chiller control and status screen.

.7 Boiler load shall be received from the boiler control panel and/or calculated from control devices.

.8 Provide a maintenance toggle switch at each boiler which will make the boiler unavailable to the control system. This will allow the boiler to start manually without effecting operation of controls.

.9 Scheduling

.1 The heating plant shall be available and operate continuously (24/7) to provide heating water to the facility and /or by Operator selectable Schedule and /or by building heating request demand.

.10 Modes of operation

.1 Plant system enable / disable

.1 The heating plant system controls shall be activated by a single enable setpoint.

.1 in "system enable" mode, all boilers, heating plant pump sequences, heating plant components, and ASHP shall be activated and made available.

.2 in "system disable" mode, all boilers, heating plant pump sequences, heating plant components, and ASHP shall be deactivated.

.2 Information from the heating plant control system (status, alarms, etc.) Shall be used to determine the "systemok" status. Refer to the "status - systemok general notes". "systemok" status shall be used to determine various allowable alarm suppressions within the BMS.

.3 Manual operation

.1 Boilers, pumps, ASHP, and other components shall be capable of manually being enabled / disabled.

.4 Automatic operation

.1 The BMS shall incorporate separate modes of operation to achieve heating water temperature setpoint based on equipment available for operation. Heating water plant modes of operation shall be determined as follows:

.2 Boiler & ASHP operation

.1 during this mode operation the boilers and ASHP shall be on

.2 this mode of operation is normally expected to occur when mild winter temperatures (max -18C) occur.

.3 When the system load continues to rise, the boiler system shall modulate to maintain heating water setpoint temperature.

.3 Boiler operation only

.1 during this mode of operation, the ASHP is off.

.2 the boiler system shall operate and modulate to maintain heating water setpoint temperature.

.11 Boiler operation

.1 The boiler manufacturer's packaged control system shall operate, startup, and shutdown the boilers, boiler components, and boiler accessories to safely maintain heating hot water supply temperature.

.2 Boiler system order of operation (cascade sequencing)

.3 The actual order of operation is the order the BMS uses to determine which boiler is started or stopped next. Actual order shall be based on the order of priority. The order of priority shall be as follows:

.1 operator override

.2 run hours (as determined by the boiler control system)

.4 On the boiler system control screen (or sub-screen), create a schedule showing the order of boiler operation. The schedule shall include the following fields:

.1 boiler - each line will display the boiler tag identification.

.2 actual order of operation - each line will display the order the boiler control system uses to determine which boiler is started or stopped next. (i.e. 1, 2, 3, 4)

.3 operator override order - this field is the only line the operator can enter values into the table. (i.e. 1, 2, 3, 4)

.4 changes are updated when the operator selects the button to update the table.

.5 if the sum of the order of operation entered by the operator is not equal to 4 the operator override is rejected, the entered values are cleared, and an error message is displayed indicating, "not every boiler is accounted for, re-enter operator override order".

.6 if the sum of the order of operation entered by the operator is equal to 4; the operator override is accepted. If the override results in starting a new boiler that is not currently in operation; the new boiler shall be started before shutting down the operating boiler.

.7 run hour order - this field is determined by the BMS or boiler control system in order to operate the boiler with the least run hours first. Boiler run order is predetermined at the same time every week. The adjustable default time for the BMS to determine the weekly run order shall be 8am each Thursday.

.8 run hours - this field displays the run hours that are calculated and tracked by the BMS or boiler control system as cumulative hours of operation since the initial start-up.

.9 status - this field shall display the status of each boiler (i.e. run / off / alarm).

.10 if the boiler status is indicated as "alarm", the BMS shall consider the boiler not available, and the next boiler in order will be started. When the alarm is cleared, the operator can select "update table" to reset the boiler status.

.11 boiler firing rate - this field shall display the boiler firing rate that is signaled from the boiler control system. The firing rate shall be reported in percentage (0% - 100%).

.12 operating conditions - this field shall display the boiler operating conditions that is signaled from the boiler control system. Operating conditions displayed shall include (but is not limited to) the following:

.1 heating hot water return temperature (°f) into boiler.

.2 heating hot water return temperature (°f) out of boiler.

.12 Startup (initial "lead" boiler)

.1 When the boiler receives a "boiler enable" signal;

.1 modulates the boiler isolation valve open and,

.2 the control system enables the appropriate pump(s) for operation.

.3 the pump associated with the enabled boiler shall be started.

.4 during the initial startup the secondary heating water pumping system shall be enabled.

.2 The boiler control system shall confirm that flow through the boiler has been achieved.

.3 The boiler control system shall confirm the gas pressure switch, blocked drain switch, and limit switch contacts are closed and the pre-purge cycle begins.

.4 The boiler control system shall confirm the blower is at the requested speed and the air pressure switch is closed.

.5 Once the pre-purge cycle is complete, the boiler control system shall lower the blower speed.

.6 The boiler control system shall initiate the boiler ignition sequence as follows:

.1 the ignition electrode enables and begins sparking.

.2 the natural gas valve modulates open.

.3 after a pre-programmed time, the ignition electrode disables, and the flame sensor checks for the presence of a flame.

.4 if the control does not detect a flame, the boiler startup will result in a safety shutdown and lockout the boiler. The boiler will be required to be manually reset.

.5 if the control detects a flame, the boiler control system will hold the blower speed and firing rate constant for a pre-programmed time to allow for the flame to stabilize.

.7 The boiler control system begins to modulate the firing rate in order to maintain the desired setpoint temperature or mode of operation.

.13 Startup (additional "lag" boiler)

.1 When the additional boiler receives a "boiler enable" signal;

.1 modulates gradually (rate of change to be determined by boiler manufacturer) the boiler isolation valve open and,

.2 the control system enables the primary pump associated with the enabled boiler for operation.

.2 The boiler control system shall confirm flow through the boiler has been achieved

.3 The boiler control system shall confirm the gas pressure switch, blocked drain switch, and limit switch contacts are closed and the pre-purge cycle begins.

.4 The boiler control system shall confirm the blower is at the requested speed and the air pressure switch is closed.

.5 Once the pre-purge cycle is complete, the boiler control system shall lower the blower speed.

.6 The boiler control system shall initiate the boiler ignition sequence as follows:

.1 the ignition electrode enables and begins sparking.

.2 the natural gas valve modulates open.

.3 after a pre-programmed time, the ignition electrode disables, and the flame sensor checks for the presence of a flame.

.4 if the control does not detect a flame, the boiler startup will result in a safety shutdown and lockout the boiler. The boiler will be required to be manually reset.

.5 if the control detects a flame, the boiler control system will hold the blower speed and firing rate constant for a pre-programmed time to allow for the flame to stabilize.

.7 The boiler control system begins to modulate the firing rate in order to maintain the desired setpoint temperature.

.14 Shutdown ("lag" boiler)

.1 Once the boiler control system determines the boiler shall be shutdown, the following is performed:

.1 the control system will close the modulating gas valve.

.2 the boiler will enter a post-purge cycle.

.3 the primary pump associated with the boiler shall enter a pre-programmed pump delay cycle prior to shut down.

.4 after the post-purge cycle has completed, the boiler control system shall verify the blower has been de-energized and the blower proving switch is open.

.5 at the end of the pre-programmed pump delay cycle, the isolation valve modulates closed and, boiler pump demand shall be disabled.

.15 Shutdown ("lead" boiler and heating plant)

.1 Once the boiler control system determines the boiler and heating plant shall be shutdown, the following is performed:

.1 the boiler control system shall verify the ASHP has been de-energized and disabled.

.2 the control system will close the modulating gas valve.

.3 the boiler will enter a post-purge cycle.

.4 the pump associated with the boiler shall enter a pre-programmed pump delay cycle prior to shutdown.

.5 after the post-purge cycle has completed, the boiler control system shall verify the blower has been de-energized and the blower proving switch is open.

.6 at the end of the pre-programmed pump delay cycle, the isolation valve modulates closed and, boiler pump demand shall be disabled.

.7 the secondary heating hot water pumping system shall be disabled, and the pumps shall be stopped.

.8 all heating plant control valves shall return to their fail-safe positions.

.16 Boiler and ASHP operation

.1 The boiler system shall be enabled and operating to allow the ASHP to be enabled.

.2 ASHP startup & operation:

.1 Refer to Section 1.26 – Chiller Plant – ASHP

.2 Same sequence applies to ASHP in producing heating glycol.

.17 Heating hot water temperature control

.1 The heating hot water generating systems, boiler and / or ASHP are enabled to operate, each boiler and / or ASHP discharge temperature is modulated to achieve a final supply temperature of 120~130F (adjustable).

.1 Maintained BAS and/ or boiler and ASHP.

.2 Note:

.1 Due to ASHP limitations the ASHP heating delta T is about 10F and maximum discharge temperature is 130F

.2 Due to limitations of ASHP, the boilers may have higher discharge temperatures (blended with the ASHP)

.3 Blended final supply temperature of 120~130F (adjustable).

.3 Secondary building return temperature is expected to be approximately 95~105F, maintaining full condensing boiler operation.

.2 The maintaining of the water temperature is done via the modulating of the boiler(s) fire rate which is automatically controlled by the BMS. For example, if the temperature begins to drop below the temperature set point, the system will increase the boiler(s) fire rate and / or ASHP to increase the supply temperature. Inversely, if the supply temperature is greater than the temperature set point, the system will decrease the boiler(s) fire rate/ or ASHP in an attempt to reduce the supply temperature.

.18 Energy Efficiency / hot water temperature control

.1 The boilers will maintain the following linear schedule of heating water supply temperatures (adjustable):

Outdoor Air Temperature	Supply Temperature
-10 C or lower	49~55 C (120~130 F)
+ 5 C or higher	38~44 C (100~110 F)

.19 Primary heating hot water pump control

.1 General

.1 The heating hot water pump system will operate by signals received from the BMS.

.2 Pump operation is interfaced with boiler enable.

.20 Enable / disable (initial startup)

.1 The BMS shall send a signal to enable the heating hot water pump(s).

.1 If "System Enable" = Yes; then "HW Pump Enable" = Yes.

.2 Else; the heating hot water pump shall remain disabled.

.2 Upon a signal from the BMS to start a pump;

.1 If "Pump Start" = Yes; start the heating hot water pump.

.2 Modulate the heating hot water pumps to maintain the water system flow 10% above the minimum required flow rate for pump to operate.

.21 Order of operation

.1 The actual order of operation is the order the BMS uses to determine which pump is started or stopped next. Actual order shall be based on the order of priority. The order of priority shall be as follows:

.1 Operator override.

.2 Run hours.

.2 On the heating hot water system control screen (or sub-screen), create a schedule showing the order of heating hot water pump operation. The schedule shall include the following fields:

.1 heating hot water pump - each line will display the heating hot water pump tag identification.

.2 Actual order of operation - each line will display the order the BMS uses to determine which pumps is started or stopped next. (i.e. 1, 2, 3, 4)

.3 Operator override order - this field is the only line the operator can enter values into the table. (i.e. 1, 2, 3, 4)

.4 Changes are updated when the operator selects the button to update the table.

.5 If the sum of the order of operation entered by the operator is not equal to 4 the operator override is rejected, the entered values are cleared, and an error message is displayed indicating, "not every pump is accounted for, re-enter operator override order".

.6 If the sum of the order of operation entered by the operator is equal to 4; the operator override is accepted. If the override results in starting a new pump that is not currently in operation; the new pump shall be started before shutting down the operating pump.

.7 Run hour order - this field is determined by the BMS in order to operate the pump with the least run hours first. Pump run order is predetermined at the same time every week. The adjustable default time for the BMS to determine the weekly run order shall be 8am each Thursday.

.8 Run hours - this field displays the run hours that are calculated and tracked by the BMS as cumulative hours of operation since the initial start-up.

.9 Status - this field shall display the status of each pump (i.e. Run / Off / Alarm).

.10 If the pump status is indicated as "Alarm", the BMS shall consider the pump not available, and the next pump in order will be started. When the alarm is cleared, the operator can select "Update Table" to reset the pump status.

.11 Pump speed - this field shall display the pump speed that is signaled from the pump VSC. The speed shall be reported in percentage (0% - 100%).

.12 Operating KW - this field shall display the pump operating power that is signaled from the pump VFD.

.22 Pump control logic

.1 General

.1 an additional pump is started automatically when starting a second boiler

.23 Operational range

.1 The pumps shall be soft started from off and operate from 25%-100% speed via the variable frequency drives to maintain the differential temperature setpoint of 25F (Adjustable) across the boiler. VFD's shall not operate below 15HZ (low limit speed shall be verified by the controls contractor with the installed pump selections surge curve).

.24 Pump failure / fault

.1 If the pump fails to start or issues an alarm due to a fault; the failed pump shall be locked out of operation and another pump shall be started.

.25 Hydraulic Bridge (low loss header) reset option

.1 Hydraulic Bridge (low loss header) flow on both primary and secondary water loops have an influence on overall system performance and temperature stability.

.2 The system is designed to operate with similar flows on primary and secondary loops, otherwise the temperatures on each loop will differ significantly.

.3 If significant difference in temperature of primary and secondary loops are observed over a period of 30 min (adjustable) reset pump flow gradually to equalize flow and also maintain design temperatures. The control contractor shall make necessary setpoint adjustments to tune the sequence in the field.

.26 Heating plant loop warmup

.1 A loop warmup sequence shall be available to prevent a spike in heating load during times the loop temperature has dropped below an acceptable temperature. The warmup sequence shall be initiated when the boiler plant has been shutdown for longer than 4 hours or by a manual override.

.2 In automatic operation:

.1 The warmup sequence shall operate as follows:

.1 If "System Disable" time > 4 hours; enable "Warmup" sequence.

.2 Else if "System Disable" time < 4 hours; "Warmup" shall not be enabled.

.3 Endif

.3 When a warmup signal is enabled the heating plant sequence shall operate as follows:

.1 If "Warmup" is enabled; "Boiler Enable" signals = 1 for a duration of 60 minutes.

.2 Elseif "Warmup" is disabled; "Boiler Enable" signals may = 1, 2, or 3.

.3 Endif

.4 When a warmup signal is enabled the heating water pump sequence shall operate as follows:

.1 If "warmup" is enabled; "pump enable" signals = 1 for a duration of 60 minutes & a maximum speed of 90%.

.2 Else if "Warmup" is disabled; "Pump Enable" signals may = 1, 2, or 3.

.3 Endif

.5 In manual operation:

.1 The warmup sequence shall operate as described in the automatic operation. After a duration of 60 minutes, the manual override "Warmup" signal shall be disabled.

.27 Heating plant load calculations

.1 Calculate total system load from the supply and return water temperatures leaving the plant and flow meter.

.2 Total LOADMBH = (TEMPHWS °F - TEMPHWR °F) x FLOWGPM x coefficient.

.28 Heating plant loss of power sequence of operation

.1 Control power

.1 All BAS control panels in the central heating water plant shall be connected to an uninterruptible power supply (UPS) to prevent loss of controls when the power is interrupted.

.29 Recovery from power loss (boilers)

.1 The purpose of this sequence is to bring the heating plant back online as quickly and smoothly as possible following a power loss.

.2 Indications:

.1 One or more boilers have tripped out, evidenced by:

.2 Boiler enabled; and

.3 Momentary power loss or phase loss alarm received from the boiler control panel.

.3 The following conditions will be expected upon restoration of power:

.1 Restart of the boilers may take 2-5 minutes.

.2 Unless controls are modified (refer to loss of power sequences), all equipment will attempt to restart at the same time.

.3 Pumps are on variable speed drives and will ramp up to previous operating conditions.

.4 While not operating pumps, cooler return temperature water migrates into the warmer heating water supply.

.5 Air handling units in the system may or may not have been affected by the power loss.

.4 Upon loss of power (loss of normal power and start of stand-by power system) where boilers and the cogeneration system have tripped offline, the following shall be done to mitigate impacts.

.1 Plant controls: initiate a 30-minute (adjustable) timer. Adjustable increments shall be made in 5-minute intervals.

.2 Heating water pump operate "on" signals shall be maintained at the position at the time of power loss. This allows the system to stagger boiler restarts by disabling and enabling boilers without an extra pumping transient.

.3 Do not allow the BAS to recalculate setpoints until the 30 minutes time delay has been completed.

.4 Heating water pumps are limited to the speed existing at the time of the power loss. This should not be accomplished by holding the plant leaving heating water differential pressure setpoint during this transient, because opening valves will affect this pressure.

.5 Prevent new boilers from coming online except as outlined below.

.6 Boiler operation: boilers shut down due to a power loss shall have their operate signals modified as follows:

.7 Lead boiler shall be maintained in the enable mode.

.8 Lag boilers, if operating before and is shut down due to power loss, shall be immediately switched to disable mode. Once confirmed restoration of power and after 90 seconds (adjustable), this boiler shall be returned to the enable mode in a cascading fashion using the set interval of time.

.9 Standby boiler shall remain in standby mode.

.10 ASHP operation: during a loss of power event, the ASHP machine might not be available supplement the heating plant.

.5 Upon returning to normal power, the heating plant will experience a second loss of power due to the open transition switch within the auto-transfer switch.

.1 The heating plant shall be restored to operation as the plant operation in a similar fashion described during the loss of normal power sequence.

.2 After the plant reaches stable operation

.3 The heat recovery chiller system shall be enabled and return to normal power operation.

.4 The ASHP system shall be enabled and return to normal power operation.

1.30 SECONDARY HOT WATER PUMP CONTROL (P - 01, 02, 03, 04)

.1 General

.1 The Building hot water pump system will operate by signals received from the BMS.

.2 The system shall operate in a duty/ standby pump configuration.

.2 Enable / disable (initial startup)

.1 The BMS shall send a signal to enable the hot water pump(s).

.2 Else; the hot water pumps shall remain disabled.

.3 Upon a signal from the BMS to start a pump;

.1 Start modulation the speed on the first hot water pump. Pump starting order shall be determined by the BMS.

.4 Order of operation

.1 The actual order of operation is the order the BMS uses to determine which pump is started or stopped next. Actual order shall be based on the order of priority. The order of priority shall be as follows:

.1 Operator override.

.2 Run hours.

.3 On the hot water pump system control screen (or sub-screen), create a schedule showing the order of hot water pump operation. The schedule shall include the following fields:

.1 hot water pump - each line will display the hot water pump tag identification.

.2 Actual order of operation - each line will display the order the BMS uses to determine which pumps is started or stopped next. (i.e. 1, 2, … etc.)

.3 Operator override order - this field is the only line the operator can enter values into the table. (i.e. 1, 2 … etc.)

.4 Changes are updated when the operator selects the button to update the table.

.5 Run hour order - this field is determined by the BMS in order to operate the pump with the least run hours first. Pump run order is predetermined at the same time every week. The adjustable default time for the BMS to determine the weekly run order shall be 8am each Thursday.

.6 Run hours - this field displays the run hours that are calculated and tracked by the BMS as cumulative hours of operation since the initial start-up.

.7 Status - this field shall display the status of each pump (i.e. Run / Off / Alarm).

.8 If the pump status is indicated as "Alarm", the BMS shall consider the pump not available, and the next pump in order will be started. When the alarm is cleared, the operator can select "Update Table" to reset the pump status.

.9 Pump speed - this field shall display the pump speed that is signaled from the pump VFD. The speed shall be reported in percentage (0% - 100%).

.10 Operating KW - this field shall display the pump operating power that is signaled from the pump VFD.

.5 Operational range

.1 The pumps shall be soft started from off and operate from 25%-100% speed via the variable frequency drives to maintain the differential pressure setpoint. VFD's shall not operate below 15HZ (low limit speed shall be verified by the controls contractor with the installed pump selections surge curve).

.6 Pump failure / fault

.1 If either the pumps fail to start or issues an alarm due to a fault; the failed pump shall be locked out of operation and the redundant pump shall be started.

.2 The original remaining operating pump shall be designated the lead pump and the redundant pump shall become the standby pump.

.7 Pump rotation

.1 If the scheduled pump rotation results in starting a new pump that is not currently in operation; the new pump shall be started before shutting down the operating pump.

.8 Pressure reset

.1 Trim and respond reset (pump differential pressure reset option #1)

.1 Using this option #1, the differential pressure setpoint is reset based on requests made by the hot water system connected to the hot water system.

.2 Differential pressure transmitters in hot water branches from each campus building shall provide a signal for pump speed control.

.3 Each sensor shall have an independent setpoint. Actual setpoint shall be optimized by the tab contractor and field verified by the commissioning agent.

.4 The controlling differential sensor/transmitter shall be the one with the greatest error signal.

.5 The other differential sensors/transmitters shall be active and report a signal to the BMS, but only the controlling differential sensor/transmitter shall provide the control signal for the pump(s) speed

.2 Critical zone reset (pump differential pressure reset option #2)

.1 Using this option #2, the differential pressure setpoint is reset based on polling all building(s) hot water valve position. Hot water valves shall send their position to the pump controller.

.2 Pump differential pressure reset shall be determined as follows:

.3 If 'Any Valve' position > 95%; the differential pressure setpoint shall be increased by 0.1 psi at a frequency of every 5 minutes.

.4 Elseif 'All Valve' positions <90%; the differential pressure setpoint shall be decreased by 0.1 psi at a frequency of every 5 minutes.

.5 Endif

.3 The differential pressure setpoint, reset increment amount, and frequency of reset shall be optimized in the field by the TAB contractor and commissioning agent.

.9 Building Hot Water temperature alarm

.1 Temperature alarm as sensed by the building hot water supply/ return temperature sensor

.1 level 3 alarm: if 5°F above or below setpoint for 10 minutes, generate a level 3 alarm at the bas & graphic user interface.

.2 level 2 alarm: if 10°F above or below setpoint for 10 minutes, generate a level 2 alarm at the bas & graphic user interface.

.10 Building Hot Water pressure alarm

.1 Pressure alarm as sensed by the building hot water supply/ return pressure sensor

.1 level 3 alarm: if 5 psi above or below setpoint for 10 minutes, generate a level 3 alarm at the bas & graphic user interface.

.2 level 2 alarm: if 10 psi above or below setpoint for 10 minutes, generate a level 2 alarm at the bas & graphic user interface

.11 Variable frequency drive fault alarm

.1 Faults generated by an associated variable frequency drive, de-energize associated pump(s).

.1 Level 2 alarm : upon report of a fault

.1 Deenergize the associated pump(s).

.2 Alarm shall be provided.

.12 Loss of power

.1 Upon loss of power, valves, etc. Shall return to their fail-safe positions.

.2 Upon restoration of power; the pump shall have a delay of 60 seconds prior to restart.

.1 All pumps shall provide a staggered start operation to minimize electrical demand surge during restart.

1.31 DOMESTIC WATER BOOSTER PUMP CONTROL

.1 General:

.1 Self-contained domestic water booster pump package.

.2 Scheduling:

.1 Continuous operation 24/7.

.3 Pressure:

.1 Monitor and trend domestic water discharge pressure.

.2 Monitor and trend domestic water suction pressure.

.4 Alarms:

.1 General fault alarm

.1 Level 3 alarm: if the controller signals an error message, generate a level 3 alarm at the BAS & graphic user interface.

.2 Discharge pressure alarm

.1 Level 2 alarm: if the system discharge pressure drops 5 psi below setpoint for 5 minutes, send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.3 Suction pressure alarm

.1 Level 2 alarm: if the system suction pressure drops 5 psi below setpoint for 5 minutes, send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.4 BMS disconnection alarm

.1 Level 3 alarm: if the BMS signals connection has been lost between the building control system and the pump controller; generate a level 3 alarm at the BAS & graphic user interface.

.5 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.32 DOMESTIC WATER RECIRC PUMP CONTROL

.1 General:

.1 The domestic hot water system consists of one hot water heater, a DHW circulating pump and tempering valve.

.2 A 3-way tempering valve is provided by others to limit the maximum domestic hot water supply temperature to the building. 3-way tempering valve is not connected to the BAS.

.2 Modes of Operation:

.1 The system is enabled to run continuously.

.2 The disabled mode can be manually set by an operator through the BAS.

.3 Enabled Mode:

.1 The circulating pump will be enabled when the DHWR temperature on the temperature sensor located furthest upstream drops below 110°F. The pump will be disabled once the temperature has been above 120°F for 10 minutes.

.4 Disabled Mode:

.1 The system is off.

.2 The circulating pump is off.

.3 Alarms:

.1 Pump failure;

.1 Level 2 alarm: on failure to run, disable the pump and send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.2 Temperature alarm:

.1 Low-temperature alarm

.1 level 3 alarm: if 10°F below lower limit setpoint for 10 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.2 level 2 alarm: if 20°F below heating lower limit setpoint for 10 minutes, generate a level 2 alarm at the BAS & graphic user interface.

.2 Low-temperature alarms shall be suppressed in the following conditions:

.1 BMS disconnection alarm

.4 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.33 DOMESTIC WATER HEATER TANK

.1 General:

.1 Self-contained domestic hot water tank.

.2 Scheduling:

.1 Continuous operation 24/7.

.3 Temperature:

.1 Monitor and trend domestic water discharge temperature.

.4 Alarms:

.1 Discharge temperature alarm

.1 Level 3 alarm: if the system discharge temperature drops 10F below setpoint for 5 minutes, send an alarm to the building control system. Generate a level 3 alarm at the BAS & graphic user interface.

.2 BMS disconnection alarm

.5 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.34 FLOW / ENERGY METERING

.1 Operation

.1 The electrical utility meter/s will be monitored through an IP communication port provided with the electrical meter.

.2 The natural gas meter/s will be monitored through pulse output provided with the meter.

.3 The water meter will be monitored through pulse output provided with the meter.

.4 Hot water and chilled glycol energy metering

.1 Calculate total energy from supply water temperature entering the building and return water temperatures leaving the building and the water flow meter through the building.

.2 Calculate total energy from supply water temperature entering, return water temperatures leaving and the water flow meter through all other submetering area/ systems and per LEED requirements.

.5 Electrical sub metering – DIV 26.

.6 Electrical sub metering utilizing VFDs (if approved by the City).

.2 BAS points

.1 The following points shall be monitored by the BAS:

.2 KW

.3 KWH

.4 PF

.5 Gas usage rate

.6 Water usage rate

.7 Hot water, Chilled glycol energy

.3 Alarms

.1 Use adjustable high and low alarm limits shall be programmed for all monitored variables

.2 Flow Meter failure:

.1 Level 2 alarm: Generate a level 2 alarm at the BAS & graphic user interface.

.3 BMS disconnection alarm

.4 Sub metering

.1 In addition to building level flow and energy metering:

.1 Provide flow and energy metering as per LEED requirements.

1.35 IN FLOOR/ SNOW MELT HEATING

.1 General

.1 Control to prevent snow accumulation due to snow falling from busses or open overhead doors.

.2 Controls described herein shall be performed by the radiant floor heating controller using electric actuation and either PI or PID control logic. PI or PID control shall be determined by the applications ability for control tuning. Provide all interface, wiring, relays, interlocks, controls, and programming as required for operation.

.2 Snow melt heating controller shall incorporate logic to protect the slab by limiting the thermal rate of rise between the supply temperature and the slab temperature.

.3 Scheduling:

.1 The system shall be made available for operation when the outside air temperature is below 45°F, adjustable by the Operator.

.2 A warm weather shutdown shall lockout the system from operation when the outdoor temperature is above 45°F.

.4 System control method:

.1 System shall be enabled to run by the Operator.

.2 Timer: enable “timer” operation of the snow melt heating system if selected by the Operator.

.5 System “Snow Storm” operation:

.1 System shall be enabled to run by the Operator.

.2 Storm operation shall temporarily pre-heat the slab to a set temperature to reduce startup time. System storm operation shall operate to maintain the slab temperature of 34°F.

.6 System start/stop control:

.1 Upon input from the snow melt heating control to initiate the system, the snow melt heating pump shall be enabled.

.2 Upon input from the snow melt heating control, the system shall modulate gradually (from cold glycol supply to hot glycol supply) the building branch heating glycol control valve to maintain slab temperature (multiple points) requirements as required by the snow melt heating control.

.3 Once the run time scheduled has expired (if Operator timer was enabled), the system will be placed into the "Off" mode and the system pump shall be disabled, and the building heating glycol valve shall close.

.7 Alarms:

.1 The snow melt heating control and/or the building control system shall report and initiate an alarm to the building control system for the following:

.1 General snow melt heating controller error / alarm

.2 Level 3 alarm: if the s snow melt heating controller signals an error message, generate a level 3 alarm at the BAS & graphic user interface.

.2 Snow melt heating pump failure alarm:

.1 Level 2 alarm: on failure to run as sensed by the current sending relay or flow switch, disable the pump and send an alarm to the building control system. Generate a level 2 alarm at the BAS & graphic user interface.

.3 Slab temperature alarm:

.1 Temperature alarm as sensed by the slab temperature sensors

.2 level 3 alarm: if 4°F above or below setpoint for 15 minutes, generate a level 3 alarm at the BAS & graphic user interface.

.3 level 2 alarm: if 8°F above or below setpoint for 15 minutes, generate a level 2 alarm at the BAS & graphic user interface

.4 BMS disconnection alarm

.1 Level 3 alarm: if the BMS signals connection has been lost between the building control system and the radiant floor heating controller; generate a level 3 alarm at the BAS & graphic user interface.

.8 Loss of power:

.1 The unit shall be programmed to allow for an automatic restart upon a power failure and restoration of power.

.2 The unit shall return to the status and operation being performed prior to the power failure.

1.36 OIL INTERCEPTOR

.1 Alarms

.1 Oil Level alarm:

.1 Level 2 alarm: on high oil level Generate a level 2 alarm at the BAS & graphic user interface.

1.37 TYPICAL SUMP PUMP

.1 Alarms

.1 High Level alarm:

.1 Level 2 alarm: on high level Generate a level 2 alarm at the BAS & graphic user interface.

.2 Level 2 alarm: general fault Generate a level 2 alarm at the BAS & graphic user interface.

1.38 ALARM DISPLAY

.1 Summary, but not limited to, of graphic display indications

POINT DESCRIPTION	DISPLAY	COMMENTS
CONTROL POINT	0 - 100% OR UNIT	% OR METRIC UNIT
AIR / FLUID TEMPERATURE	^{O}C	ALARM AS NOTED IN SEQUENCE
FILTER/ HEAT EXCHANGER/ DIFFERENTIAL PRESSURE STATUS	KPA	ALARM ON DIRTY FILTER / HEAT EXCHANGER CONDITION
HIGH OR LOW TEMPERATURE SENSOR (SWITCH) CONDITION	NORMAL/ ALARM	ALARM ON UNIT SHUTDOWN
FLOW INDICATION	L/S	ALARM AS NOTED IN SEQUENCE
TOTAL FLOW INDICATION	L/S	DISPLAY ALL READINGS AND THE TOTAL RESULT
TEMPERATURE	^{O}C	ALARM ON OUT-OF-RANGE
AVERAGE TEMPERATURE	^{O}C	DISPLAY ALL READINGS AND THE AVERAGE RESULT
HOA SWITCH POSITION	VFD / HOA	ALARM AS NOTED IN SEQUENCE
FAN OR PUMP L-O-R SWITCH POSITION	LOCAL/ OFF/ REMOTE	ALARM AS NOTED IN SEQUENCE
START/ STOP COMMAND	ON/ OFF	DISPLAY
VFD FAULT	NORMAL/ FAULT	ALARM ON FAULT
VFD OR FAN NOT AVAILABLE (DISCONNECT OR OVERLOAD OPEN)	OPEN/ CLOSED	ALARM ON OPEN
VFD STATUS	ON/ OFF	ALARM ON DISAGREEMENT BETWEEN START/ STOP COMMAND AND STATUS
MOTOR STATUS (FROM CONTACTOR)	ON/ OFF	ALARM ON DISAGREEMENT BETWEEN START/ STOP COMMAND AND STATUS
FAN STATUS (VFD-DI)	ON/ OFF	ALARM ON DISAGREEMENT BETWEEN FAN AND VFD STATUS
FAN STATUS (STARTER CURRENT)	ON/ OFF	ALARM ON DISAGREEMENT BETWEEN START/ STOP COMMAND AND STATUS
PUMP STATUS (STARTER CURRENT)	ON/ OFF	ALARM ON DISAGREEMENT BETWEEN START/ STOP COMMAND AND STATUS
MOTOR OR VFD CURRENT INDICATION	AMPS	POTENTIAL FAN BELT OR PUMP IMPELLER BROKEN

POINT DESCRIPTION	DISPLAY	COMMENTS
VFD SPEED INDICATION	0-100%	ALARM AS NOTED IN SEQUENCE
HIGH OR LOW PRESSURE SWITCH	NORMAL/ ALARM	ALARM ON UNIT SHUTDOWN
PRESSURE INDICATION	KPA	ALARM ON OUT-OF-RANGE
EMERGENCY STOP	NORMAL/ STOP	ALARM ON STOP
SMOKE DETECTOR, FIRE ALARM	NORMAL/ ALARM	ALARM ON UNIT SHUTDOWN
OUTDOOR RELATIVE HUMIDITY	RH %	RELATIVE HUMIDITY, ALARM ON OUT-OF-RANGE
PUSH BUTTON	ON / OFF	ALARM IN ON POSITION FOR MORE THAN 4 HOURS (OPERATOR ADJUSTABLE)
STOP/ STROBE LIGHT	ON / OFF	ALARM ON POSITION
GAS DETECTION	NORMAL/ ALARM	ALARMS AS NOTED IN SEQUENCE
LACK OF PRESSURE REGIME (POSITIVE / NEGATIVE)	NORMAL/ ALARM	ALARMS AS NOTED IN SEQUENCE
HYDRONIC LOOP LOW/ HIGH PRESSURE	NORMAL/ ALARM	LOW PRESSURE / FLOOD ALERT HIGH PRESSURE CHECK MAKEUP/ PRV ALARM ON OUT-OF-RANGE
SYSTEM	ON / OFF	DISPLAY SYSTEM START / STOP
TIME DELAY	ON	DISPLAY NOTIFICATION
SETPOINTS	MEASUREMENT UNIT	OPERATOR ADJUSTABLE DISPLAY MIN-MAX RANGE
GENERAL FAULT / GENERAL ALARM / ALARM	ON / OFF	ALARMS AS NOTED IN SEQUENCE
OUTDOOR AIR FLOW INDICATION	L/S	ALARM IF +/- 15% FROM SETPOINT

1.39 INDOOR DESIGN CRITERIA

.1 The following is the intended indoor environmental conditions:

Space/ Design Condition	**Winter**	**Summer**
Administration Areas		
Occupied Areas	**22ºC**	**24ºC**
Unoccupied Areas	**18ºC**	**28ºC**
Space Humidity **(1)**	**30% (+/- 10%)**	**50% (+/- 10%)**
Bus Storage Areas		

Occupied **(2)**	**10ºC**	**Up to 35 ~ 37ºC**
Space Humidity **(3)**	**n/a**	**n/a**
Bus Turning Area (Bull Pen)		
Occupied **(2)**	**10ºC**	**Up to ~ 35ºC (5)**
Space Humidity **(3)**	**n/a**	**n/a**
Countdown Areas (fueling, cleaning, bush wash)		
Occupied **(2)**	**20ºC**	**Up to 30ºC (6)**
Unoccupied **(2)**	**18ºC**	**Up to 35ºC**
Space Humidity **(3)**	**n/a**	**n/a**
Repair / Maintenance Garage		
Occupied **(2)**	**20ºC**	**Up to 27ºC (6)**
Unoccupied **(2)**	**18ºC**	**Up to 35ºC**
Space Humidity **(3)**	**n/a**	**n/a**
Storage and Parts rooms (Garage)		
Occupied **(2)**	**20ºC**	**Up to 30ºC (6)**
Unoccupied **(2)**	**18ºC**	**Up to 35ºC**
Space Humidity **(3)**	**n/a**	**n/a**
Service rooms (mech, elec rooms)		
Occupied **(2)**	**20ºC**	**Up to 35ºC**
Unoccupied **(2)**	**18ºC**	**Up to 35ºC**
Space Humidity **(3)**	**n/a**	**n/a**
Service rooms (IT, COM rooms)		
(2)	**20ºC**	**Up to 28ºC**
Space Humidity **(4)**	**10~90% noncondensing**	**n/a**

Notes:

All values depicted are not absolute and have tolerances based on industry standards.

.1 Humidity is monitored and controlled in heating mode. Setpoint compensation based on outdoor air reset.

.2 The values have implication on the equipment selection, capital, and operational cost of the facility.

.3 Humidity is not monitored and not controlled. Refer also to Note 5 & 6 for summer mode.

.4 Humidity not controlled. Based on final purchased IT, COM equipment requirements, humidity control may be added.

.5 Although this space is considered unoccupied, partial air tempering (cooling) is provided to provide improved environmental conditions, allow for some daytime electrical bus charging and for climate resilience.

.6 Air tempering (cooling) is provided to provide improved environmental conditions and assist in ASHRAE 55 compliance.

END OF SECTION

1 General

1.1 REFERENCE

.1 Division 00 and Division 01 apply to and are a part of each Electrical Division Section.

1.2 APPLICATION

.1 This Section specifies products, criteria and characteristics, and methods and execution that are common to one or more Sections of Electrical Divisions. It is intended as a supplement to each Section of Electrical Divisions and is to be read accordingly.

.2 Be responsible for advising product vendors of requirements of this Section.

1.3 SUBMITTALS

.1 Submit shop drawings for products of this Section.

.2 Additionally, as part of shop drawing submission process, submit following to Contract Administrator for review:

.1 sample of each proposed type of access door if supplied under work of this Division, as well as electronic copies of reflected ceiling plan drawings and wall elevation drawings showing proposed access door locations;

.2 dimensioned location drawings indicating required sleeves and formed openings in structural poured concrete or precast concrete construction or in roofing, and locations of cutting or drilling required for Electrical Divisions work;

.3 samples of materials and any other items as specified in succeeding Sections of Electrical Divisions;

.4 weight loads of selected equipment (upon request);

.5 equipment nameplate and warning sign proposed nomenclature, print type, symbols, sizing and colours;

.6 fire stopping installation drawings with ULC certifications;

.7 copies of prior to start of construction approvals from local governing authorities having jurisdiction.

.3 Prior to application for Substantial Performance of the Work, submit following to Contract Administrator for review (note: funds will be withheld until each of following items have been completed and documented to satisfaction of City and reviewed with Contract Administrator):

.1 fire alarm system testing and verification report of each component of work; devices to be certified working and in proper order;

.2 final distribution system testing and arc flash study performed and documented to satisfaction of Contract Administrator;

.3 structured network cabling system tested and verified to be operating and performing in accordance with specified standards.

1.4 CONTINUITY OF SUPPLY FOR STANDARDIZATION

.1 Utilize materials of one manufacturer for aspects of work, where practical. Utilize one common manufacturer for wiring devices, such as switches and receptacles, whether installed loose or in a pre-manufactured component. Coordinate with each supplier and ensure conformance with this requirement. Identify deviations to Contract Administrator and obtain approval of change prior to proceeding with work.

2 Products

2.1 DUCT FOR DIRECT BURIED CABLES

.1 DB/2 solid wall rigid PVC duct and fittings, CSA Certified, tested to CSA Standard C22.2 No. 211.1.

.2 Synthetic polypropylene fibre (plastic) twine cord or 19 mm (3/4") diameter polyethylene rope, and where required approved by local governing Utility.

2.2 CONDUITS

.1 EMT (Thinwall), galvanized electrical metallic tubing to CSA C22.2 No. 83, complete with factory made bends where site bending is not possible and joints and terminations made with steel couplers and steel set screw type connectors with insulated throats, and concrete tight where required by local governing codes. Provide raintight type fittings where EMT is exposed to water spray of activated sprinklers.

.2 Rigid galvanized steel to CSA C22.2 No. 45, with exterior zinc and interior enamel coatings, galvanized threads where factory cut and red lead coated threads where site cut. Factory made bends where site bending is not possible, factory made and threaded fittings, and connectors, and terminations with rigid couplings, and concrete tight where required.

.3 Hot dipped zinc galvanized steel core, flexible liquid tight metallic conduit to CSA C22.2 No. 56, with flame retardant PVC jacket, complete with terminations consisting of ULC listed, suitable for wet locations, gasketed, steel or iron construction, liquid-tight flexible conduit connectors at terminations.`

.4 Galvanized steel flexible metallic conduit to CSA C22.2 No. 56, complete with proper and suitable squeeze type connectors at terminations.

.5 CSA approved and labelled, FT-4 rated, rigid PVC conduit complete with site made heat gun bends on conduit to 53 mm (2") diameter, factory made elbows in conduit larger than 53 mm (2") diameter, solvent weld joints, factory made expansion joints where required, and terminations made with proper and suitable connectors and adaptors.

.6 Medium density CSA certified polyethylene flexible plastic conduit in a continuous coil of proper length.

.7 Columbex Green-Guard corrosion resistant, flame resistant, salt spray resistant, steel rigid conduit to CSA C22.2 #45, with flexible baked epoxy coating of nominal thickness 0.08 mm (0.003") that is uniformly applied to outside surface of conduit. Inside surface of conduit is uniformly coated with epoxy acrylic of nominal thickness 0.05 mm (0.002"). Coatings do not contain any lead, chrome, or chlorinated compounds. Boxes, couplings, accessories and hardware to be also epoxy coated.

2.3 OUTLET BOXES

.1 CSA approved stamped galvanized steel outlet boxes.

.2 Eaton Crouse-Hinds., CSA certified, "FS" or "FD" Series cast Feraloy and aluminium outlet boxes.

.3 CSA certified rigid plastic (PVC) outlet boxes.

.4 Standard general purpose service floor boxes: CSA approved, UL scrub water compliant, fully adjustable angular and vertically, cast iron for on-grade, formed steel for above grade, round single gang / rectangular or square multi-gang as required, flush in concrete floor installation, boxes complete with conduit knockout openings, adjustable collars, hinged flip open brass covers with provisions for mounting of duplex power receptacles, telephone jacks and data jacks. Provide barriered boxes when boxes contain both power and communication outlets and different voltage levels. Size boxes to suit thickness of floor slab as reviewed with Contract Administrator and also to suit required bending radii of conductors. Refer to drawings for number of gang requirements. Acceptable manufacturers are Hubbell, Legrand and Thomas & Betts. Special floor boxes are specified elsewhere in another Section.

.5 Columbex Green-Guard or equivalent Robroy, corrosion resistant, flame resistant, salt spray resistant, boxes uniformly coated inside and outside with epoxy acrylic of nominal thickness 0.05 mm (0.002"). Covers to be secured with stainless steel screws.

.6 Each outlet box and back box to be suitable in respects for application and complete with suitable securing lugs, connectors suitable for connected conduit, knockouts and, where necessary, suitable plaster rings, concrete rings, covers, carpet flanges and any other required accessory.

.7 Electrical boxes exposed exterior of building or in non-climate controlled locations to be weatherproof boxes complete with gasketted covers/faceplates.

2.4 PULLBOXES AND JUNCTION BOXES

.1 Galvanized or prime coat plated steel, suitable in respects for application and complete with screw-on or hinged covers as required, and connectors suitable for connected conduit.

.2 Eaton Crouse-Hinds, "Condulet", threaded cast Feraloy outlet boxes of an exact type to suit application, each complete with screw-on gasketted cover.

.3 Rigid PVC, CSA certified, junction boxes and access fittings with solvent weld type joints and screw-on PVC covers.

.4 Columbex Green-Guard corrosion resistant, flame resistant, salt spray resistant, boxes uniformly coated inside and outside with epoxy acrylic of nominal thickness 0.05 mm (0.002"). Covers to be secured with stainless steel screws.

.5 Physical size of pullboxes to be as required by local governing electrical code to suit number and size of conduits and conductors.

.6 Each box to be suitable in respects for application and complete with suitable securing lugs, connectors suitable for connected conduit, knockouts and, where necessary, suitable plaster rings, concrete rings, covers and any other required accessory.

.7 Boxes exposed exterior of building or in non-climate-controlled locations to be weatherproof boxes complete with gasketted covers.

2.5 SLEEVES

.1 Galvanized steel sleeves as follows:

.1 No. 24 gauge with an integral flange at one (1) end to secure sleeve to formwork construction;

.2 Schedule 40 pipe.

.2 Schedule 40 PVC sleeves.

2.6 FIRESTOPPING AND SMOKE SEAL MATERIALS

.1 Asbestos-free, elastomeric materials and intumescent materials, tested, listed and labelled by ULC in accordance with CAN/ULC S115, and CAN/ULC S101 for installation in ULC designated firestopping, and smoke seal systems to provide a positive fire, water and smoke seal and a fire resistance rating (flame, hose stream and temperature) no less than fire rating for surrounding construction.

.2 Firestopping and smoke seal material system to be specifically ULC certified with designated reference number for its specific installation. As part of shop drawing submission, submit copies of firestopping drawings with ULC certificate and system number for each specific installation.

.3 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with firestopping manufacturer's recommendations and ULC tested assembly. Coordinate material requirements with trades supplying abutting areas of materials.

.4 Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.

.5 For typical standard indoor applications for conduit and cable installations to seal openings up to 25 mm (1"): Hilti "Cable Disc CFS-D 1", pre-formed firestopping solution with features as follows:

.1 Approximate Density 1.6 g/cm^3;

.2 Mold and mildew resistant;

.3 Surface burning characteristics (UL 723 (ASTM E84): Flame spread: 0 and Smoke development: 5;

.4 Application temperature 0 to 40°C (32-104°F);

.5 Percent Fill: up to 100% per tested system;

.6 Sound Transmission classification (ASTM E 90): 62 (Relates to specific construction).

.6 For typical standard indoor applications to seal openings up to 1800 mm x 900 mm (72" x 36"): Hilti "Firestop Block (CFS-BL)", ready-to-use, intumescent flexible block designed for:

.1 Sealing single or multiple penetrations of openings;

.2 Temporary or permanent sealing of cables and cable tray penetrations;

.3 Temporary or permanent sealing of conduit penetrations.

.7 Firestop Block (CFS-BL) features as follows:

.1 Tested in accordance with CAN/ULC-S115, UL 1479, ASTM E 814 and ASTM E 84;

.2 Halogen, asbestos, solvent free and smoke resistant;

.3 Operational immediately after installation;

.4 Application temperature 5°C to 40°C (40°F to 104°F);

.5 Temperature resistance -15°C to 60°C (5°F to 140°F);

.6 Intumescent activation approximately 200°C (392°F);

.7 Expansion ratio (unrestricted) Up to 1:3;

.8 Surface burning characteristics (ASTM E 84-10b): Flame Spread Index: 10 and Smoke Development Index: 15;

.9 Sound transmission classification (ASTM E 90): STC Rating: 52;

.10 Suitable for wet areas when applied with additional silicone coating to manufacturer’s directions.

.8 For applications where fire rated firestopping cable pathway system is to be special structurally reinforced, reusable and require no or minimal alterations to firestop component when cables are either added or removed, provide Hilti “Speed Sleeve CP 653” with features as follows:

.1 Tested in accordance with CAN/ULC-S115, UL 1479 and ASTM E 814;

.2 Re-penetrable cable management device for electrical and telecom cables;

.3 Smoke gaskets;

.4 50 mm (2") or 100 mm (4") diameter opening models to suit specific applications;

.5 Total length: 315 mm (12.4");

.6 Temperature resistance -6°C to 100°C (-22° F to 212°F);

.7 Intumescent activation approximately 160°C (320°F);

.8 Expansion ratio (unrestricted) 1:40;

.9 Construction: metal steel with zinc coating, plastic ABS and fabric glass-fibre;

.10 Structure to be sturdy enough to stand up to constant modification and use, but maintain its ULC firestopping rating.

.9 Supply products of a single manufacturer for use on work of this Division.

.10 Installer to be manufacturer trained and certified on specific product. Submit copy of certificate with shop drawings.

.11 Include for manufacturer's authorized representative to inspect and verify each installation and application. Submit test report signed and verified by system installer's authorized representative and manufacturer's representative.

.12 Acceptable certification to also include certification by Underwriters Laboratories of Northbrook IL, using tests conforming to ULC-S115 and given cUL listing published by UL in their "Products Certified for Canada (cUL) Directory".

.13 Acceptable manufacturers are:

.1 Hilti Canada;

.2 Specified Technologies Inc.;

.3 3M Canada Inc.;

.4 Tremco;

.5 A/D Fire Protection Systems;

.6 Nelson.

2.7 FASTENING AND SECURING HARDWARE

.1 Concrete inserts - Crane Canada Ltd., No. 4-M for concrete work for single or double conduit, cable tray, etc., runs and equipment. Unistrut Ltd. multiple type inserts for runs of three (3) or more conduits etc., or where a grid support system is required.

.2 Concrete fasteners – "WEJ-IT" anchors, lead cinch anchors and/or "STAR" or "PHILLIPS" self-drilling anchors.

.3 Masonry inserts – "WEJ-IT" expansion shields and machine bolts or, for light loads, fibre or lead plugs and screws.

.4 Drywall or plaster wall and/or ceiling fasteners – 2-wing spring toggles.

.5 Structural steel - Crane Canada Ltd., beam clamps.

.6 Anchors, fasteners and other securing hardware to be of capacity and type to suit application and for which materials to which hardware are being installed. Include manufacturer's product literature with shop drawing submissions detailing that supplied hardware is suitable for respective applications. Arrange for manufacturer's representative to provide onsite installation training for hardware products.

.7 Metal framing channels – typical 40 mm (1-5/8") width but increased where required to suit application, galvanized steel channels complete with required fittings and ancillary hardware. Acceptable manufacturers of framing channels are:

.1 Unistrut;

.2 Thomas & Betts;

.3 Hilti;

.4 Eaton B-Line.

.8 Acceptable manufacturers of fastening and securing hardware:

.1 Crane;

.2 Hilti;

.3 Thomas & Betts.

.9 Pentair Erico metal "J" hooks or Panduit "J-Pro" cable support systems for communications system cabling in accessible ceiling spaces were conduit or cable tray is not being provided. J hooks to be of type and size to maintaining cable minimum bending radii of cable being supported and have smooth edges that cannot damage cable. Clearly identify cable manufacturer's bending radii specifications and submit with shop drawings. Use of J-hooks is subject to approval from City and review with Contract Administrator.

.10 Velcro tie wraps for bundling and securing cables.

2.8 ACCESS DOORS

.1 Access doors to be provided under work of Division 08 by General Trades Contractor.

.2 Coordinate with Mechanical Contractor and General Trades Contractor to ensure that access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and that work involving both mechanical and electrical services to where possible be accessible from common access door. Coordinate work to ensure that same common location access doors are not supplied by more than one Division.

.3 Size access door to suit concealed work for which they are supplied and wherever possible they are to be of standard size for all applications, but in any case, they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.

.4 Access doors in fire rated ceilings, walls, partitions, structures, etc., to be ULC listed and labelled and of a rating to maintain fire separation integrity.

.5 Identify on reflected ceiling plans and wall elevation drawings, coordinated locations of proposed access door locations and submit to Contract Administrator for review.

2.9 IDENTIFICATION NAMEPLATES

.1 Laminated plastic (Lamacoid) black-white-black with bevelled edges, stainless steel screws, and proper identification engraving. Each nameplate to be sized to suit equipment for which it is provided and required wording. Various colour configurations to be used to differentiate systems. Confirm exact nomenclature, sizing, print type and colour scheme with City and review with Contract Administrator.

.2 Brother "P-Touch" or approved equal, portable electronic labelling system complete with self-adhesive, permanent printed labels with required nomenclature.

.3 For non-climate-controlled areas: nameplates to be weather resistant, corrosion resistant and UV resistant to prevent fading. Mounting hardware to be corrosion resistant stainless-steel construction.

2.10 SIGNAGE

.1 Thomas & Betts Ltd., or approved equal, semi-rigid vinyl panels with drilled holes in each corner, stainless steel screws, pressure sensitive mounting pads on back, and required printed wording. Generally, wording to be red on a white background with black trim confirmed with City and reviewed with Contract Administrator.

.2 For non-climate-controlled areas: signage to be weather resistant, corrosion resistant and UV resistant to prevent fading. Mounting hardware to be corrosion resistant stainless-steel construction.

.3 Warning signage to comply with applicable requirements of local governing authorities and codes.

2.11 SYSTEM BACKBOARDS

.1 FSC (Forest Stewardship Council), G1S (good one side) construction grade fir plywood, containing no added urea formaldehyde, flame retardant prime coat painted on exposed surfaces, minimum 20 mm (3/4") thick, as sized on drawings and with flame spread rating in accordance with local governing building code requirements.

2.12 MOTOR STARTER PANELS

.1 Minimum No. 14 gauge sheet steel panels complete with steel angle reinforcing, framing and suitable splitter trough, fully primed and enamel painted, sized to accommodate starters required with spare space and capacity for at least two additional units.

2.13 SPRINKLER PROTECTION

.1 Provide drip shields for protection of surface mounted equipment enclosures from water spray and dripping of liquids. Features of shields include:

.1 factory constructed by respective equipment manufacturers;

.2 constructed from non-combustible materials (sheet steel);

.3 enamel painted to match equipment;

.4 surfaces and edges filled/sanded smooth prior to painting;

.5 supported from equipment with structural steel rods/metal framing or other method reviewed with Contract Administrator;

.6 structural support finish painted to match shield.

.2 Include with equipment shop drawings, detailed dimensions of drip shields and methods of supporting.

.3 Equipment with top cable/conduit entries to include additional sealing of entries with gasketting and/or waterproof sealant to prevent water from entering enclosure.

.4 Design ventilation louvers such that live components are not exposed to water spray and dripping liquids.

.5 Above requirements are additional minimum "sprinkler protection" standards for equipment specified as NEMA / (EEMAC) 1, 2 or 12.

.6 Obtain CSA approval where required by local governing authorities.

2.14 ROOFTOP CONDUIT SUPPORT SYSTEM

.1 Cooper B-Line "Dura – Blok" series rooftop support systems with features as follows:

.1 CSA approved and/or ULC listed and labelled;

.2 non-penetrating of roof;

.3 vibration dampening;

.4 does not float;

.5 suitable for outdoor wet and freezing environments without damage caused by weather or freeze and thawing when exposed to de-icing chemicals;

.6 environmental friendly;

.7 constructed of recycled rubber.

.2 Materials:

.1 Dura-Blok Curb base made of 100% recycled rubber and polyurethane pre-polymer with a uniform load capacity to suit specific load application of support (minimum 744 kg/m (500 pounds/linear foot)); each base to have a reflective red stripe.

.2 DB Series base: Dimensions: 150 mm (6") wide by 125 mm (5") tall by required overall length (minimum 225 mm (9")); this is to be minimum dimensions, but base requirements must be increased to suit specific applications as recommended by system manufacturer; includes low base steel frame C channel 1.9 mm (14 gauge) – 25 mm (1") high strut galvanized per ASTMA653; and pipe roller assembly.

.3 DBE Series elevated: base with two 13 mm (1⁄2") dia electro zinc all threaded rod risers and 14 ga. 25 mm (1') high galvanized steel slotted channel; adjustable height up to 400 mm (16"); refer to drawings or confirm with Contract Administrator for exact height requirements.

.4 Attaching hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633.

.5 Conduit clamps: single pipe supports constructed of galvanized steel and sized to accommodate sizing of installed conduits.

.3 Confirm with system manufacturer that selected products provide proper support for application.

.4 Acceptable manufacturers are as follows:

.1 Cooper B-Line;

.2 Clearline Technologies (C-Port);

.3 Erico (Caddy Pyramid).

3 Execution

3.1 GENERAL INSTALLATION REQUIREMENTS

.1 Install conduit concealed in finished areas, and concealed to degree made possible by finishes in partially finished and unfinished areas. Conduit may be exposed in unfinished areas such as Electrical and Mechanical Rooms, unless otherwise noted on drawings or specified herein. Refer to and examine architectural drawings and room finish schedules to determine finished, partially finished or unfinished areas of building. Documents do not identify exact routing. Where shown, routing is diagrammatic, identifying general requirements of routing and locations. Include for necessary offsets, fittings, transformations and similar items required as a result of obstructions and other architectural or structural details not shown.

.2 Where conduits are exposed, arrange them to avoid interference with other work, parallel to building lines and install as high as possible. Do not install conduits within 150 mm (6") of "hot" pipes or equipment unless conduits are associated with equipment. Independently run conduit to be supported from wall/ceiling structure, not from ceiling hangers, ductwork, piping, cable trays, formed steel decking, etc. Do not run conduits within 900 mm (3') of equipment access opening covers.

.3 Where conduit is proposed to be embedded within structural concrete, obtain City's approval and review with Contract Administrator (Structural Engineer). Install such conduit in compliance with requirements of latest edition of CSA Standard CAN3-A23.1, "Concrete Materials, and Methods of Concrete Construction". Confirm and review with Structural Contract Administrator, proper installation practices and methods. In areas where Contract Administrator has directed conduit not to be embedded in concrete, run conduits through beams via sleeved openings pre-coordinated and reviewed with Contractor and by Contract Administrator (Structural Engineer). Do not embed conduit runs in concrete slab of parking garage areas, unless approved by City and reviewed with Contract Administrator.

.4 So as not to impair required strength of structure, following criteria to be generally followed but which is to be reviewed and coordinated with Contract Administrator prior to start of Work:

.1 where conduits pass by a column, stay at least two times thickness of slab and drop away from column;

.2 where conduits terminate adjacent to a column or wall, bring conduit in toward column/wall as close to 90° to face of column as possible within two times thickness of slab and drop away from column;

.3 maximum size of conduit in structural slabs is 1/5 of solid portion of slab thickness;

.4 where more than two conduits are adjacent to each other, they are to be spaced greater of 3 diameters or 100 mm (4") apart;

.5 total of depth of conduits crossing over each other is to be less than one-third thickness of slab;

.6 place conduit in middle third of thickness of slab; do not lay conduit directly on reinforcing steel;

.7 do not run conduit adjacent to parallel reinforcing bars;

.8 do not run conduit longitudinally in beam without approval of City and review with Contract Administrator; pass through beams at right angles to span of beam;

.9 where conduits pass through beams, maintain at least twice depth of beam separation away from supports;

.10 do not run conduits in slab beside a drop or beam within twice depth of slab from edge of drop or beam;

.11 do not run conduits through shear walls or columns without approval of City and review with Contract Administrator;

.12 do not place conduit in structural elements in parking garage structures, water retaining structures or structures subjected to de-icing chemicals, without approval of City and review with Contract Administrator.

.5 For proposed use of conduit runs underground below slab include following provisions:

.1 concrete encased ductbank with conduits of non-ferrous materials and sloped to drain properly into pit;

.2 proper drain pit;

.3 system to be a pull-in system;

.4 20% spare conduits (with minimum of at least 1);

.5 system proposal to consider and address any effects of magnetic fields.

.6 Conduits are sized on drawings, but in absence of type and sizing, type and size to suit intended application in accordance with applicable local governing electrical code requirements. Sizes identified on drawings are minimum sizes and are not to be decreased unless approved by City and reviewed with Contract Administrator.

.7 Where receptacle type devices are located in existing floors and/or where feeds are required to furniture systems in open spaces, and where chasing of floor slab to run conduit is not acceptable to City, after review with Contract Administrator provide fire rated "poke-thru" assembly installed through floor and feed from conduit runs provided in ceiling space of floor below.

.8 Mounting heights of devices may be typically identified on drawings, but such dimensions are for general pricing only. Review exact mounting heights with Contract Administrator prior to roughing –in, refer to Architectural drawings and comply with local governing codes and standards including building code barrier free requirements.

3.2 INSTALLATION OF DUCT FOR DIRECT BURIED CABLES

.1 Provide ducts as required for running direct buried cables as noted. Install in accordance with applicable local governing authority codes and standards and manufacturer’s recommendations and instructions. Coordinate Work with trades responsible for performing excavation and backfill Work. Confirm requirements with local authority having jurisdiction. Refer to drawings for additional requirements.

.2 Support direct buried underground ducts on a well-tamped flat bed of earth, free from rocks or protrusions of any kind. Grade and slope bed to provide ducts with proper drainage. Coordinate with General Trades Contractor for provision of means to carry away drainage water. Obtain required approvals of work from local governing electrical utility and review with Contract Administrator prior to back filling and covering. Provide pull cord in each duct run.

.3 Use standard duct lengths and fittings as much as possible and practicable. When cutting is necessary, carefully taper duct ends with special field tapering machine. Make joints by means of manufacturer's standard couplings. Maintain minimum bending radius of 1 m (3.3'). Use manufacturer's solvent cement and primer, and procedures for joint fitting connections.

.4 Provide sloping and drainage of ducts to prevent pooling of water within ducts. Review requirements with Contract Administrator prior to start of Work.

.5 Provide manufactured expansion joints in duct at spacing as recommended by duct manufacturer.

.6 When duct has been laid, draw a steel test mandrel through each duct in presence of Contract Administrator. Diameter of mandrel to be 13 mm (1/2") less than inside diameter of duct. Remove obstruction found in duct to satisfaction of Contract Administrator and leave duct system completely clear. No conduit will be accepted as being ready for installation of feeders until this is done.

.7 Whenever Work is suspended, protect ends of ducts by means of suitable plugs and leave such plugs in use as long as may be necessary. When duct is installed for future extension, plug end of ducts for protection.

.8 Provide marking tape and marking pavers as required by local governing authorities and as reviewed with Contract Administrator.

.9 Provide one continuous length of polyethylene rope or Brantford twine in each duct indicated as spare or for future use.

3.3 INSTALLATION OF CONDUIT

.1 Provide conduit for conductors except armoured cable and copper sheathed mineral insulated conductors, and except where duct or similar raceway materials are provided.

.2 Provide conduit as follows:

.1 for interior building surface mounted conductors greater than 600 V – rigid galvanized steel;

.2 for conductors exceeding 600 V for main distribution wiring in Electrical rooms, and for concealed conduit in exterior walls-rigid galvanized steel;

.3 for exposed conduit outside building, for semi-exterior areas such as loading areas and within parking garage floor areas – rigid galvanized steel (rigid PVC where permitted by local codes and City and reviewed with Contract Administrator);

.4 for exposed conduit in non-climate-controlled areas, in areas of corrosive elements – epoxy coated ridged galvanized steel;

.5 for branch circuit conductors underground inside building, and underground outside building beneath concrete, asphalt, and similar paving material-rigid PVC;

.6 for branch circuit conductors underground outside building clear of concrete, asphalt and similar paving material-flexible polyethylene plastic conduit;

.7 for conductors in surface mounted conduit of parking garage – rigid galvanized steel; conduit not to be embedded in concrete within parking garage areas, unless approved in writing by City and reviewed with Contract Administrator; if approved, rigid PVC may be used embedded in concrete slabs;

.8 for exposed conduit mounted at a height of less than 2400 mm (8') in electrical, mechanical or other areas – rigid galvanized steel;

.9 for short branch circuit connectors to motorized equipment and distribution transformers (minimum length 450 mm (18"), maximum length 600 mm (24") with 180° loop where possible) – galvanized steel flexible liquid-tight conduit;

.10 at points, where conductors cross building expansion joints – galvanized steel flexible conduit with no less than 600 mm (24") of extra curve;

.11 for branch circuit conductors in poured concrete slab – rigid PVC;

.12 for interior conduit above 53 mm (2") diameter containing distribution conductors or communication systems conductors (fire alarm, telephone etc.) (except as noted above) – EMT with separate insulated ground conductor;

.13 for corrosive environments – epoxy coated rigid steel;

.14 for conductors except as noted above or elsewhere in this Specification – EMT.

.3 Run rigid conductors in rigid type conduits suitable for application. Do not use flexible conduit.

.4 Secure conduit located in poured concrete work in place in a manner such that conduit will not float or move when concrete is poured. Adequately protect such conduit from damage prior to and during concrete pour, and from concrete and water penetration.

.5 Review with Contract Administrator prior to Start of Work, maximum allowable size of conduit for installation in poured concrete. Placement of reinforcing steel in structural concrete work will take precedence over placement of conduit. Spaced adequately multiple runs of conduit in poured concrete work, as reviewed with Contract Administrator.

.6 Install flexible polyethylene conduit in continuous lengths wherever possible and "snake" conduit in trench. Where joints are necessary, make same with nylon inserts and stainless-steel gear type clamps. Terminate with rigid conduit threadless connectors. Grade bed to provide proper drainage of conduits.

.7 Support underground conduit on a well-tamped flat bed of earth, free from rocks or protrusions of any kind. Grade and slope bed to provide conduits and ducts with proper drainage. Coordinate with General Trades Contractor for provision of means to carry away drainage water. Obtain required approvals of work from local governing electrical utility and review with Contract Administrator prior to back filling and covering. Provide pull cord in each duct run.

.8 Provide manufactured expansion joints in rigid PVC plastic conduit at spacing as recommended by conduit manufacturer.

.9 Provide a separate ground conductor in plastic conduits.

.10 Support and secure surface mounted and suspended single or double runs of metal conduit at support spacing in accordance with local governing electrical code requirements by means of galvanized pipe straps, conduit clips, ringbolt type hangers, or by other proper manufactured devices.

.11 Support multiple mixed size metal conduit runs with Unistrut Ltd., Electrovert Ltd. "CANTRUSS" or Burndy Ltd. "FLEXIBLE" conduit racks spaced to suit spacing requirements of smallest conduit in group.

.12 Unless otherwise noted, provide conduit fittings constructed of same materials as conduit and which are suitable in respects for application.

.13 Provide proper adaptors for joining conduits of different materials.

.14 Cut square and properly ream site cut conduit ends.

.15 Handle, install and thread epoxy coated conduit in accordance with manufacturer's instructions as not to damage epoxy coating. Seal joints with manufacturer's sealing compound.

.16 Provide conduit as sized on drawings. Size conduit not sized on drawings in accordance with local governing electrical code with consideration that sizes of branch circuit conductors indicated are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with voltage drop schedule found on drawings or at end of this section. Where conductor sizes are increased to suit voltage drop requirements, increase scheduled or specified conduit size to suit. Unless otherwise noted on drawings or required by local governing electrical code or specified elsewhere, conduit to be of minimum size 13 mm (1/2") diameter. Structured network cabling system conduit to be of minimum 19 mm (3/4") diameter, unless otherwise noted.

.17 Site made bends for conduit to maintain full conduit diameter with no kinking, and conduit finishes are not flake or crack when conduit is bent.

.18 Plug ends of roughed-in conduits which are exposed during construction with approved plugs.

.19 Ensure that conduit systems which are left empty for future wiring are clean, clear, capped and properly identified at each termination point. Provide end bushing and suitable fish wires in such conduits.

.20 Provide empty conduits to ceiling spaces from flush mounted panelboards located below and/or near hung ceiling. Refer to drawing detail.

3.4 EXPANSION FACILITIES FOR CONDUIT CROSSING BUILDING EXPANSION JOINTS

.1 Wherever concealed or surface mounted conduits cross building expansion joints, provide expansion facilities to permit free movement without imposing additional stress or loading upon support system, and to prevent excessive movement at joints and connections, in accordance with drawing details and local governing inspection approvals.

3.5 INSTALLATION OF OUTLET BOXES AND BACK BOXES

.1 Provide an outlet box or back box for each luminaire, wiring device, telephone outlet, fire alarm system component, communications systems components, and each other such outlet.

.2 Size boxes to accommodate exact supplied components and for bending radii of installed cables. Confirm requirements with respective system vendors.

.3 Outlet boxes flush mounted in interior construction, surface mounted in concealed interior locations, and surface mounted in exposed interior locations where connecting conduit is EMT, to be stamped and galvanized steel outlet boxes unless otherwise noted.

.4 Outlet boxes for surface mounted exterior lighting, receptacles, and other device outlets, boxes flush mounted in exterior building surfaces, and boxes mounted in interior device locations where connecting conduit is rigid and boxes in perimeter wall where insulation and vapour barrier is present, and boxes in non-climate-controlled areas to be "FS" or "FD" Series cast boxes unless otherwise noted.

.5 Provide sealing around boxes in walls where insulation and vapour barrier is present or for walls of rooms that are sealed. Maintain sealing system of wall.

.6 Outlet boxes in plastic conduit systems to be rigid PVC plastic outlet boxes, unless otherwise noted.

.7 Outlet boxes for flush floor mounted devices to be concrete tight formed galvanized steel fully adjustable flush floor boxes. Locate in to position and install in accordance with manufacturer’s instructions. Coordinate installation with trades pouring concrete floor slab or trade responsible for floor construction.

.8 Provide barriered outlet box for switches connected to normal and emergency power and share a common faceplate.

.9 Provide epoxy coated boxes for epoxy coated conduit. Handle and install epoxy coated boxes in accordance with manufacturer’s instructions as not to damage epoxy coating. Seal joints with manufacturer’s sealing compound.

.10 Provide outlet boxes for special wiring devices, for special equipment and special applications. Refer to requirements specified in other Sections and/or on drawings.

.11 Size and arrangement of outlet boxes to suit device which they serve.

.12 Mounting heights and locations for outlet boxes are typically indicated on drawings, however confirm exact location and arrangement of outlets prior to roughing-in. Architectural drawings and Contract Administrator’s instructions have precedence over electrical drawing diagrammatic layouts and specified mounting heights and locations.

.13 Do not install outlet or back boxes "back-to-back" in walls and partitions. Stagger such outlets and seal against noise transmission in accordance with drawing details. "Thru-wall" type boxes will not be permitted for any application.

.14 Properly support exterior mounted boxes for receptacles as noted on drawings. Where location is not adjacent a structure, provide rigid conduit support properly imbedded into ground and secure box at suitable required height. Review exact installation requirements with Contract Administrator prior to start of work.

.15 Provide blank coverplates over boxes left empty for future installation of devices. Clearly identify each box as to its intended use, to City’s approval and reviewed with Contract Administrator. Generally, provide stainless steel type blank coverplates.

3.6 INSTALLATION OF PULLBOXES AND JUNCTION BOXES

.1 Provide pullboxes in conduit systems wherever shown on drawings, and/or wherever necessary to facilitate conductor installations. Generally, conduit runs exceeding 30 m (100") in length, or with more than two - 90° bends, are to be equipped with a pullbox installed at a convenient and suitable intermediate accessible location.

.2 Size boxes to accommodate exact supplied system and for bending radii of installed cables. Confirm requirements with respective system vendors.

.3 Provide junction boxes wherever required and/or indicated on drawings and as required by local governing electrical code.

.4 Provide sealing around boxes in walls where insulation and vapour barrier is present or for walls of rooms that are sealed. Maintain sealing system of wall.

.5 Boxes in rigid conduit and EMT inside building to be stamped galvanized or prime coated steel.

.6 Boxes in exterior rigid conduit and boxes in perimeter wall where insulation and vapour barrier is present, to be "Condulet" cast gasketted boxes, unless otherwise noted.

.7 Boxes in plastic conduit to be rigid PVC plastic boxes complete with required couplings.

.8 Provide epoxy coated boxes for epoxy coated conduit. Handle and install epoxy coated boxes in accordance with manufacturer’s instructions as not to damage epoxy coating. Seal joints with manufacturer’s sealing compound.

.9 Pullboxes and junction boxes to be accessible after work is completed.

.10 Accurately locate and identify concealed pullboxes and junction boxes on "As-built" record drawings.

.11 Clearly identify main pull or junction boxes (excluding obvious outlet boxes) by painting outside of covers. Spray painting is not permitted unless approved by City and reviewed with Contract Administrator. Paint colours to be in accordance with following schedule:

.1 lighting-yellow;

.2 normal power-blue;

.3 essential power-orange;

.4 fire alarm-red;

.5 telephone-green;

.6 miscellaneous signals-brown.

.12 In addition to painting miscellaneous signal boxes, clearly identify specific system in which box is installed.

.13 Cover boxes in fire walls with aluminium tape and seal with caulking.

3.7 INSTALLATION OF SLEEVES

.1 Where conduits, round ducts and conductors pass through structural poured concrete, provide sleeves of type suitable for application, and approved by local governing codes.

.2 Sleeves in concrete slabs, except as noted below, are to be No. 24 gauge or equivalent, with an integral flange to secure sleeves for formwork construction.

.3 Sleeves in waterproof concrete slabs and in other slabs where waterproof sleeves are required are to be lengths of Schedule 40 pipe sized to extend 100 mm (4") above floor.

.4 Sleeves in poured concrete walls and foundation are to be Schedule 40 pipe.

.5 Size sleeves, unless otherwise noted, to leave 13 mm (1/2") clearance around conduit, duct, conductor, etc. Void between sleeves and conduit, duct, conductors, etc., to be packed and sealed for length of sleeves as in accordance with article entitled "Firestopping and Smoke Seal Materials" specified here in this Section. Pack and seal sleeves set in exterior walls with governing authority approved materials suitable for application and pack both ends of sleeves watertight with approved permanently flexible and water tight materials. Coordinate exact responsibility of work with General Trades Contractor.

.6 Submit to concrete reinforcement detailer at proper time, drawings indicating required sleeves, recesses and formed openings in poured concrete work. Completely and accurately dimension such drawings and relate sleeves, recesses and formed openings to suitable grid lines and elevation datum.

.7 Supply sleeves of a water protecting type in accordance with detail found on drawings for installation in following locations:

.1 in Mechanical and Fan Room floor slabs, except where on grade;

.2 in slabs over Mechanical, Fan, Electrical and Telephone Equipment Rooms or closets;

.3 in floors equipped with waterproof membranes.

.8 "Gang" type sleeving to be permitted only with approval of City and reviewed with Contract Administrator.

.9 Terminate sleeves for work which is exposed, so that sleeve is flush at both ends with wall, partition, or slab surface such that sleeve may be covered completely by escutcheon plates.

3.8 INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS

.1 Where work penetrates or punctures fire rated construction, provide ULC certified, listed and labelled firestopping and smoke sealing packing material systems to seal openings and voids around and within raceway and to ensure that continuity and integrity of fire separation is maintained. Openings not in immediate vicinity of working areas are to be firestopped and sealed same day as being opened.

.2 Install firestopping and smoke seal materials for each installation in strict accordance with specific ULC certification number and manufacturer's instructions. Comply with local governing building code requirements and obtain approvals from local building inspection department. Ensure that openings through fire separations do not exceed maximum size wall opening, and maximum and minimum dimensions indicated in ULC Guide No. 40 U19 for Service Penetration Assemblies and firestopping materials.

.3 Ensure that continuity and integrity of fire separation is maintained and conform to requirements of latest edition of ULC publication "List of Equipment and Materials, Volume II, Building Construction".

.4 Comply with following requirements:

.1 Manufacturer's installation instructions for each specific application.

.2 Clean areas and surfaces before materials are installed.

.3 Examine substrates, openings, voids, adjoining construction and conditions under which firestop and smoke seal system is to be installed. Confirm compatibility of surfaces.

.4 Verify penetrating items are securely fixed and properly located with proper space allowance between penetrations and surfaces of openings.

.5 Report any unsuitable or unsatisfactory conditions to Contract Administrator in writing, prior to commencement of work. Commencement of work will mean acceptance of conditions and surfaces.

.6 Mask where necessary to avoid spillage and over coating onto adjoining surfaces. Remove stains on adjacent surfaces.

.7 Prime substrates in accordance with product manufacturer's written instructions.

.8 Provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing.

.9 Tool or trowel exposed surfaces to a neat, smooth, and consistent finish.

.10 Remove excess compound promptly as work progresses and upon completion.

.5 Notify Contract Administrator when work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of work by local governing authority inspector prior to concealing or enclosing work. Make any corrections required.

.6 On completion of firestopping and smoke sealing installation, submit a Letter of Assurance to Contract Administrator certifying the firestopping and smoke sealing installation has been carried out throughout the building to service penetrations and that installation has been performed in strict accordance with requirements of local governing building code, any applicable local municipal codes, ULC requirements, and manufacturer's instructions.

.7 Manufacturer's authorized representative to inspect and verify each installation and provide a test report signed by installing trade and manufacturer's representative. Test report to list each installation and respective ULC certification and number.

3.9 INSTALLATION OF FASTENING AND SECURING HARDWARE

.1 Provide fasteners, anchors and similar hardware required for conduit, duct, raceway, conductors, etc. and for equipment hanger and/or support material unless otherwise noted.

.2 Accurately and properly set concrete inserts in concrete framework. Where multiple type inserts are used, space same to suit requirements of smallest conduit, etc., in group.

.3 Fasten hanger and support provisions to masonry with expansion shields and machine bolts, or, for light loads, use plugs, and screws.

.4 In drywall or plaster walls and/or ceilings use two wing toggles and for heavy loads, provide steel anchor plates with two or more toggles to spread load.

.5 Provide beam clamps for attaching hanging and/or support provisions to structural steel, or where approved by City and reviewed with Contract Administrator, weld hanging and support provisions to structural steel.

.6 Install devices in accordance with manufacturer's instructions to suit each respective application.

.7 Explosive powder actuated fasteners are not permitted unless specific approval for their use and type has been obtained from City and reviewed with Contract Administrator.

.8 Under no circumstances use ceiling suspension hangers or grids for suspension of conduit and conductors. Install supports to permanent structure of building, limited to areas that will not damage structural stability.

.9 Install Velcro tie wraps on bundled telecommunication cables and do not over tighten. Provide FT6/CMP rated wraps in plenum type spaces as per local building code requirements.

.10 Comply with Contract Administrator's (Structural Engineer's) limitations for maximum penetrations of securing hardware into concrete slabs.

3.10 INSTALLATION OF IDENTIFICATION NAMEPLATES

.1 For each piece of electrical distribution equipment from electrical source of supply up to and including panelboards, for special control panels and cabinets, and for each other piece of electrical equipment, provide engraved Lamacoid identification nameplates secured to apparatus with stainless steel screws. Nameplates to indicate source of electrical supply and include Contract Administrator's equipment identification number. Identify whether equipment is on "NORMAL POWER SYSTEM" or "ESSENTIAL POWER SYSTEM", where applicable.

.2 Equip large multiple cell or component apparatus such as switchboards and distribution panels with main nameplates identifying equipment, voltage characteristics, capacity and source of supply, and with sub-nameplates clearly identifying each cell or component and its service.

.3 Panelboard nameplates to identify panelboard number as designated on drawings, unless otherwise instructed. Nameplates for disconnect switches, control panels, and cabinets to outline their service and source of supply.

.4 In areas where equipment having removable doors that can be commonly installed on different equipment, ensure that each door is identified to which piece of equipment it is associated with, such that nameplates are with correct equipment.

.5 Above identification nameplate and nomenclature requirements are for typical requirements for pricing only.

.6 In pull boxes, junction boxes and at terminations, identify feeders by use of plastic plates indicating system voltage and circuit designations. Plates to be 25 mm (1") in diameter and have letter stamped 9 mm (5/8") high. Colour coding to be:

.1 Phase A – red;

.2 Phase B – black;

.3 Phase C – blue;

.4 Neutral – white;

.5 Ground - green.

.7 Review print size type and size, colours, sizing and nomenclature of nameplates with Contract Administrator prior to ordering. Submit sample board.

3.11 INSTALLATION OF TERMINAL BACKBOARDS

.1 Provide specified terminal backboards for communication systems and electrical distribution equipment.

.2 Securely wall mount each backboard with proper fasteners to suit wall construction.

.3 Unless otherwise noted, size backboards to sufficiently provide adequate terminal space for each system, plus 20% space for future additions.

3.12 INSTALLATION OF SIGNAGE

.1 Provide signage as required.

.2 Provide warning signs as applicable for following:

.1 on doors into transformer vaults;

.2 on doors into high voltage switchgear rooms;

.3 on doors to genset room;

.4 on doors into main electrical rooms;

.5 for other applications as noted.

.3 Secure signs to equipment with stainless steel screws. Number of signs required and sign wording, symbols, and colours to be approved by City and reviewed with Contract Administrator, and local electrical utility and other governing authorities, where applicable.

3.13 INSTALLATION OF ROOFTOP SUPPORT SYSTEM

.1 Install rooftop support system for conduits/raceways in accordance with manufacturer's instructions and recommendations to suit type of raceway and roofing materials.

.2 If gravel top roof, remove gravel from around and under pipe support. Coordinate work with building roofing vendor confirmed with City and reviewed with Contract Administrator.

.3 Consult existing roofing vendor for roof membrane compression capacities and roof loading limitations. Comply with restrictions.

.4 Use properly sized clamps to suit conduit sizes. Ensure that installation and use of system does not invalidate existing roof warranties.

.5 Engage existing roofing vendor to inspect installation and verify that installation has not damaged roof.

3.14 BRANCH CIRCUIT BALANCING

.1 Connect branch lighting and power circuits to panelboards so as to balance actual loads (wattage) within 5%. If required, transpose branch circuits when work is complete to meet this requirement.

.2 Perform necessary tests to show compliance with above requirement. Make such tests after building is occupied and document into testing report.

3.15 EQUIPMENT BASES AND SUPPORTS

.1 Provide equipment bases, supports and concrete housekeeping pads for mounting of floor standing equipment and luminaire pole bases.

.2 Secure floor mounted equipment in place on 100 mm (4") high concrete housekeeping pads, 100 mm (4") wider and longer than equipment base dimensions. Chamfer edges of bases. Include for seismic restrains as required by local governing building code.

.3 Supply dimensioned drawings, templates, and anchor bolts for proper setting of equipment on bases and pads. Be responsible for required levelling, alignment, and grouting of equipment.

.4 Submit to Contract Administrator for review, dimensioned shop drawings of structurally designed concrete pads or bases for support of large, heavy equipment. Indicate on shop drawings total weight of pad or base, reinforcement, and equipment for which it is required.

.5 Unless otherwise noted, support equipment suspended above floor level with suitable welded or bolted prime coat painted structural steel angles or channels bracketed to wall or secured by hanger rods.

3.16 CONCRETE WORK

.1 Unless otherwise noted, concrete required for electrical work is to be provided as part of Work of Division 03. Coordinated exact requirements (sizes, locations) with General Trades Contractor.

.2 Layout, mark, coordinate and work with Division 03 contractor as required for installation of concrete necessary for duct banks, housekeeping pads, cubed openings, etc.

3.17 EXCAVATION AND BACKFILL

.1 Before commencement of excavation for work, determine in consultation with Contract Administrator, City, Municipality and utilities, presence, if any, of existing underground services at site. Engage local utilities to locate and mark out such services. Ensure that trades concerned are aware of their presence.

.2 Be responsible for any damage done to underground services caused by neglect to determine and mark out location of such services prior to excavation work commences.

.3 Inverts and locations of existing site services may have been site surveyed and approximate location may be shown on drawings. Be responsible for confirming that inverts and locations are correct, prior to commencing excavation. Where discrepancies are found, immediately inform Contract AdministratorContract Administrator, and await a direction.

.4 Where Work falls under jurisdiction of local governing utility, confirm requirements and comply with utility requirements.

.5 Provide excavation, backfill, and related work required for work. Obtain a copy of soil test report if available from City or Contract AdministratorContract Administrator. Depth of excavations must accommodate local governing requirements and local standard practices to compensate for local frost levels of Place of Work.

.6 Grade bottom of excavation. In firm, undisturbed soil, lay services directly on soil. Backfill excess excavation with 13,790 kPa (2,000 psi) concrete. Grade bottom such that ducts are installed to drain as reviewed with Contract AdministratorContract Administrator.

.7 Prepare new bedding under service in unstable soil, in fill, and in cases where bedding has been removed in earlier excavation, particularly near perimeter walls of buildings, and at manholes and catch basins, compact to maximum possible density and support service by means of 200 mm (8") thick concrete cradles spanning full length between firm supports. Refer to detail on drawings.

.8 Where excavation is necessary in proximity to and below level of any footing, backfill with 13,790 kPa (2,000 psi) concrete to level of highest adjacent footing. Proximity is determined by angle of repose as reviewed with Contract AdministratorContract Administrator.

.9 Do not open trenches ahead of installation of services and backfilling more than weather permits. Break up rocks and boulders and remove by drilling and wedging. Do not use blasting unless specifically permitted by City and reviewed with Contract AdministratorContract Administrator.

.10 Before backfilling, arrange for inspection of work by Contract AdministratorContract Administrator Do not backfill work unless reviewed with Contract AdministratorContract Administrator. Failure to do so prior to backfilling will require re-excavating work and re-backfill at no additional cost to City. Remove shoring during backfilling.

.11 Backfill trenches within building with clean sharp sand in individual layers of maximum 150 mm (6") thickness, compacted to a density of 100% Standard Proctor. Hand compact first layers up to compacted level of 300 mm (12") above top of service. Hand or machine compact balance up to grade using approved equipment.

.12 Backfill trenches outside building (not under roads, parking lots or traffic areas), up to a compacted level of 450 mm (18") above service with Granular "A" material, hand compacted to a density of 95% Standard Proctor. Backfill balance with 150 mm (6") layers of approved excavated material compacted to 95% Standard Proctor density, using approved equipment.

.13 Backfill trenches outside building under roads, parking lots or traffic areas with granular "A" material in layers not exceeding 150 mm (6") thickness, compacted to 100% Proctor density up to grade level.

.14 Fill depressions to correct grade level with appropriate material, after an adequate period has passed to reveal any settlement. Use maximum possible compaction. Pay costs required to make good damages caused by settlement. Generally, final surface toppings are responsibility of another Division of Work. Coordinate exact requirements with Contractor to ensure surface toppings are provided as required to match adjacent surfaces.

.15 Unless otherwise directed in Division 02 and/or 31, store and dispose of excavated materials as follows:

.1 during progress of contract, place material as directed in such a manner that minimum damage or disfigurement of ground and which in no causes way impedes progress of work;

.2 separately place surplus topsoil and subsoil as directed; leave site clean and unencumbered.

.16 Provide pumping equipment as required to keep excavations free of water.

.17 Engage services of independent soils testing agency to test final backfill compaction density of each backfilled location. Compact backfill to satisfaction of testing agency and in accordance with Specification. Submit a copy of testing agency's report to Contract Administrator for review.

.18 Coordinate requirements for final surface toppings (concrete, asphalt, pavers, grass sod, etc.) with Contractor.

3.18 FINISH PAINTING OF ELECTRICAL WORK

.1 Unless otherwise noted, finish painting of exposed Electrical Divisions work is to be performed as part of work of Division 09.

.2 Provide identification painting for electrical distribution equipment in accordance with application requirements of Division 09. Review exact finish colours with Contract Administrator. Equipment requiring special colour identification painting to include but not be limited to following:

.1 pull boxes and junction boxes;

.2 communication system conduit;

.3 genset exhaust piping.

.3 Spray painting is not permitted unless approved in writing by City and reviewed with Contract Administrator.

3.19 PROVISIONS FOR FURNITURE SYSTEMS

.1 Ensure that rough-in for electrical devices including but not limited to outlets, switches, thermostats, control devices, fire alarm devices and clocks and communications devices are located to avoid wall mounted systems furniture wall strips. Relocate conduit and devices which do not coordinate with systems furniture requirements identified on systems furniture drawings.

.2 Coordinate location of electrical conduits/ducts within floor slabs and mounted to underside of floor slabs, with location of free-standing work stations and furniture systems.

.3 Coordinate connection of electrical and communication devices with systems furniture supplier. Generally, supply and installation of power, data and communication wiring and devices are by Electrical Division. Furniture system connection "whips" to be supplied by furniture system vendor and turned over to Electrical Division for installation. Confirm responsibility of supply of whip with General Trades Contractor. Power conductors are to be installed to a wall/ceiling mounted junction box and extended out to furniture system, through empty conduit, raceways, and back boxes provided within furniture system. Branch circuit conductors in furniture system raceways may be AC-90 flexible armoured conductors. Telecommunication (data/voice) conductors are to be complete home runs from LAN closet to work station outlet. Testing and verification of furniture system devices is responsibility Electrical Division. Confirm exact requirements with furniture system trades. Where furniture systems are not supplied with pre-wired devices, be responsible for supply, installation and wiring of required devices.

3.20 CONDUIT PROVISIONS FOR MISCELLANEOUS SYSTEMS

.1 Provide following components to accommodate future installation of various miscellaneous systems by system installers who are to provide equipment and wiring:

.1 conduit - diameters as sized on drawings with non-metallic fish wires or pull cords and suitable bushings for conduit terminations, and as specified in Part 2; provide labelling at each end to clearly identify each conduit run with respect to system and path;

.2 outlet boxes - standard galvanized steel, each complete with a blank type faceplate, and as specified in Part 2;

.3 pull boxes, junction boxes, back boxes and sleeves - and as specified in Part 2.

.2 Miscellaneous systems are typically as shown on drawings. Unless otherwise noted on drawings, provide dedicated conduit runs for each system. Coordinate sizes of boxes with respective system vendors to ensure proper sizing to accommodate components and that allows for wiring bending radii. Confirm conduit and box requirements also with system vendors.

.3 Provide pullboxes in conduit runs longer than 30 m (100') or having more than two - 90 bends. Size pullboxes to be at least 8 times entering conduit in length. Pullbox sizes to comply with respective system standards.

.4 Leave conduits free and clear of all obstructions and terminate as required. Equip terminations with bushing, and clearly identify each run. Provide fish wires in all empty conduits. Run telecommunications conduits to comply with separation from sources of electromagnetic radiation as per standard ANSI/TIA/EIA-569. Site bend telecommunications conduit elbows to comply with system conduit bending radii requirements.

.5 Review exact requirements and locations of equipment with Contract Administrator and respective system installers prior to roughing-in.

.6 Refer to system riser diagrams on drawings.

.7 Quantities for outlets to be as per floor plan drawings and not riser diagrams.

3.21 DOOR HARDWARE

.1 Generally, Division 08 or another Division not under scope of Electrical Contractor, is responsible for supply and installation of door alarm contacts, door holders, electric strikes, electromagnetic locks, door operator controls, power supplies, door controllers, central electromagnetic lock release controller and other door hardware. Coordinate and confirm with General Trades Contractor and respective equipment vendors (door hardware / security) exact responsibility of each Division of the Work.

.2 Submit as part of shop drawing submission, detailed responsibility matrix identifying work and responsibilities of each trade and required interconnections.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Specific reference is made to the following sections:

.1 Section 01 33 00, Submittal Procedures

.2 Section 26 05 00, Basic Electrical Materials and Methods

1.2 CODES AND STANDARDS

.1 ICEA S-108-720 Standard for Extruded Insulation Power Cables Rated Above 46 Through 500 kV AC

.2 IEEE 48 Standard for Test Procedures and Requirements for Alternating Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5kV through 765kV or Extruded Insulation Rated 2.5kV through 500kV

.3 IEEE 400 Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5kV and Above

.4 IEEE 400.2 Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (less than 1 Hz)

.5 IEC 60840 Power Cables with Extruded Insulation and their Accessories for rated voltages above 30 kV up to 150 kV – Test Methods and Requirements

.6 ANSI/NETA Acceptance Testing Standard

2 Products

2.1 HIGH VOLTAGE CABLES

.1 CSA approved, 100% insulation level, min. 90°C rated. Cable to be as follows:

.1 Insulation Voltage Rating – Nominal 66 KV cable shall be rated to maximum voltage of 72.5 KV,

.2 Conductor Material – high conductivity compact round stranded copper,

.3 Conductor Size – 500 kcmil,

.4 Strand Screen – extruded semi-conducting,

.5 Insulation – EPR or XLPE

.6 Insulation Screen – extruded semi-conducting,

.7 Shield – 5 mil uncoated copper tape,

.8 Outer Jacket – Polyvinyl chloride (PVC)

.9 Terminators – See below,

.10 Outdoor rated and moisture resistant,

.11 Direct buried.

.2 Cables to be lead free and Restriction of Hazardous Substances (RoHS) compliant.

.3 Maximum continuous operating temperature rating of 90°C, with an emergency overload rating of 140°C,

.4 Each cable to be continuous with no splices.

.5 Perform field voltage testing as per cable manufacturer's instructions.

.6 Acceptable manufacturers are:

.1 Okonite, Southwire or approved equal.

2.2 HIGH VOLTAGE CABLE TERMINATIONS TO TRANSFORMER

.1 Pfisterer HV-Connex:

.1 CSA approved,

.2 Meets requirements of IEC 60840 for voltage ratings of 72.5 kV,

.3 Maximum continuous operating temperature rating of 105°C (221°F), with an emergency overload rating of 140°C (284°F),

.4 Plug-in dry type cable termination,

.5 Outdoor rated,

.6 Material copper,

.7 Voltage rated at 72.5 KV,

.8 Basic Insulation Level at 350 kV,

.9 Maximum current rating at 2500 A,

.10 Diameter per cable requirements.

.2 Provide exact termination type as per termination manufacturer's recommendations to match (or exceed where applicable) cable properties including following:

.1 Voltage class rating and insulation BIL level,

.2 Conductor material, conductor size and cable/shielding type,

.3 Indoor or outdoor application.

.3 Install termination kits in accordance with manufacturer's detailed instructions. Prepare cable for accommodating termination in accordance with termination kit manufacturer's instructions. Install proper lugs using matching size die and crimping tool. After installation has been completed and inspected, hi-pot test termination as per manufacturer's recommendations.

.4 Acceptable manufacturers are:

.1 PFISTERER

2.3 HIGH VOLTAGE CABLE TERMINATIONS ON CABLE RISER POLES

.1 Cold shrink termination kit:

.1 CSA approved,

.2 Meets requirements of IEEE 48, Class 1,

.3 Outdoor rated,

.4 Voltage rated at 72.5 KV,

.5 Basic Insulation Level at 350 kV,

.6 Diameter per cable requirements.

.2 Provide exact termination type as per termination manufacturer's recommendations to match (or exceed where applicable) cable properties including following:

.1 Voltage class rating and insulation BIL level,

.2 Conductor material, conductor size and cable/shielding type,

.3 Outdoor application.

.3 Install termination kits in accordance with manufacturer's detailed instructions. Prepare cable for accommodating termination in accordance with termination kit manufacturer's instructions. Install proper lugs using matching size die and crimping tool. After installation has been completed and inspected, hi-pot test termination as per manufacturer's recommendations.

.4 Acceptable manufacturers are:

.1 3M, or approved equal

3 Execution

3.1 PROJECT CONDITIONS

.1 Cable routing on drawings is schematic and approximate. Route cable as required to meet project conditions. Determine exact routing and lengths on site.

3.2 CO-ORDINATION

.1 Co-ordinate electrical work and with of other trades.

.2 Determine required separation between cable and other work.

.3 Determine cable routing to avoid interference with other work.

.4 Submit any alternative cable routing to Contract Administrator for review prior to proceeding with work.

3.3 INSTALLATION OF HIGH VOLTAGE CABLES

.1 Utilize high voltage Contractors to provide cable and installation work. Installation of cables and terminations are to be made by personnel skilled in this type of work.

.2 Unless otherwise noted, install cable on the cable riser pole and direct buried to the transformer cabinet.

.3 Provide ancillary mounting hardware to provide a proper installation. Install cables in accordance with manufacturer's spacing criteria.

.4 Run and install cables and hardware in accordance with local electrical governing authority requirements and codes.

.5 Determine cable lengths with care using field measurements where possible so that wastage is kept to a minimum. Cable runs are to be continuous with no splicing.

.6 Ensure that each cable is continuous with no splices. Provide separate grounding conductors as required.

.7 Ground shielding is required at each termination, unless instructed otherwise and verified.

.8 Take necessary precautions in handling cable on reels, as well as when installing in conduit, to ensure that no damage will result. Pull cables in accordance with best Standard Practices, as recommended by cable manufacturer.

.9 Provide a cable support and pullbox in conduit where shown and/or required.

.10 Take necessary precautions when handling cable on reel to ensure that no damage results in uncoiling process. While cable is being pulled, inspect sheath for any visible cracks or other damage. Immediately stop pulling cables if damage is evident, and replace or repair cable immediately. When pulling, except for short runs, use a pulling eye attached directly to conductors that make up cable. Use CSA approved cable lubricants. When pulling cable, apply pulling tension to conductor not in sheath of cable. Cable pulling tension to be as recommended by cable manufacturer. Seal cable ends to prevent entrance of moisture.

.11 Handle and terminate cables and shielding with stress cones or other terminations as noted and to recommendations and instructions of cable manufacturer to suit application.

.12 Perform the following acceptance testing methods of cables before putting into service:

.1 AC Dielectric Withstand

.2 Insulation Resistance (Megger)

.3 Polarization Index

.4 Very Low Frequency (VLF)

.5 Dissipation factor (tan delta)

.13 Do not exceed IEEE/IEC guide and manufacturer's recommended test voltage or duration. Submit test report to the Contract Administrator for review and acceptance prior to energization.

3.4 CLEANING

.1 Upon completion, remove surplus materials, rubbish, tools and equipment.

3.5 WARRANTY

.1 The Vendor shall provide a complete warranty for all equipment, labor and materials for the arresters valid for a period of 2 years from the date following Substantial Completion of the Winnipeg North Garage Replacement construction contract.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Specific reference is made to the following sections:

.1 Section 01 33 00, Submittal Procedures

.2 Section 26 05 00, Basic Electrical Materials and Methods

1.2 CODES AND STANDARDS

.1 CSA C68.10 - Shielded Power Cable for Commercial and Industrial Applications, 5-46 kV

.2 IEEE 400 Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5kV and Above

.3 IEEE 400.2 Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (less than 1 Hz)

.4 ANSI/NETA Acceptance Testing Standard

1.3 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00 and Section 26 05 00.

.2 Product Data:

.1 Provide Manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address,

.3 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with manufacturer’s recommendations in clean, dry and well-ventilated area.

.2 Store and protect the cables from nicks, scratches and blemishes.

.3 Replace defective or damaged materials with new.

2 Products

2.1 GENERAL

.1 Use armored type High Voltage (HV) TECK cables for 12.47 kV cable applications.

.2 All conductors (including grounds and bonds) shall be high conductivity copper.

.3 Materials to be manufactured to Canadian CSA standards, approved and suitable for operation at -40°C to 40°C, and installation at minimum temperatures of -25°C. Wires and cables shall meet the applicable CSA standard for construction and testing.

.4 Insulation voltage rating: 12.47kV cable shall be rated to a minimum of 15 kV.

.5 Increase conductor sizes to account for loading, cable and conductor spacing with the associated de-rating factors, voltage drop, ambient temperature, equipment termination temperature ratings, and all other requirements in accordance with CEC requirements.

.6 Cabling shall be compliant with the following flame test requirements:

.1 CSA FT-4

.2 IEEE 383 (70,000 BTU/hr)

.3 UL 1581 (70,000 BTU/hr)

.4 IEEE 1202 (70,000 BTU/hr) CSA FT-4

.5 ICEA T-30-520 (70,000 BTU/hr)

.6 ICEA T-29-520 (210,000 BTU/hr)

.7 Other required compliances:

.1 EPA 40 CFR, part 261 for leachable lead content per TCLP

.2 OSHA acceptable

.3 RoHS Compliant

.4 Meets CSA cold bend test at -40 degrees C

.5 Meets CSA cold impact test at -40 degrees C

2.2 HV-TECK CABLE

.1 Cables: to CSA- C68.10

.2 Phase Conductors: Class B compact stranded high conductivity copper.

.3 Conductor Shield: Thermosetting semi-conducting polymeric strand shield extruded over the conductor.

.4 Insulation: Tree-retardant cross-linked polyethylene (TR-XLPE).

.1 For 133 percent insulation level cables insulation thickness shall be 220 mils (minimum).

.5 Insulation Shield: A semi-conducting thermosetting layer, applied in a triple extrusion process plus a helically applied copper tape shield in contact with a bare stranded copper bonding conductor.

.1 Tape shield shall be a 5 mil annealed bare copper tape with a maximum 20 percent gap, and a minimum 10 percent overlap.

.2 Colored tape placed longitudinally under the copper tape shield. Color code: Red, Black and Blue.

.6 Bonding conductor: A bare stranded copper bonding conductor which shall be in direct contact with the copper insulation shielding tape.

.7 Inner jacket: Lead-free, flame retardant, moisture and sunlight resistant Polyvinyl Chloride (PVC), black in colour.

.8 Fully filled polypropylene fillers.

.9 Armour: helically wound interlocked aluminum (steel armor is not acceptable).

.10 Outer jacket: Lead-free, Acid-flame-check flame retardant, moisture and sunlight resistant, FT4, “HL” rated polyvinyl chloride (PVC) material, suitable for direct burial, red in color. The outer jacket shall be permanently marked (identified) in accordance with CSA C68.10, Section 12.

.11 Acceptable Manufacturer: Prysmian, Southwire or approved equal.

2.3 CABLE CONNECTORS / FITTINGS:

.1 Weatherproof strain relief style connectors, to accommodate cable shield, as recommended by the cable manufacturer.

.2 Acceptable Cable Connectors: Thomas and Betts type Star TECK® sized for the applicable cable complete with locknut and grounding bushing or approved equal.

2.4 HV-TECK CABLE TERMINATIONS

.1 Shielded Cable Conductor Terminations: Cold shrink type cable terminations appropriately sized to the conductor and insulation dimensions.

.1 For inside or weather protected applications, terminators shall be without sheds.

.2 For outdoor non-weather protected installations, terminators shall be equipped with sheds.

.2 Acceptable Cable Terminations: 3M, TE Raychem or approved equal.

3 Execution

3.1 PROJECT CONDITIONS

.1 If identified in documents, verify that field measurements and conditions are as identified.

.2 Cable routing on drawings is schematic and approximate. Route cable as required to meet project conditions. Determine exact routing and lengths on site.

3.2 CO-ORDINATION

.1 Co-ordinate work with other electrical work and of other trades.

.2 Determine required separation between cable and other work.

.3 Determine cable routing to avoid interference with other work.

.4 Submit any alternative cable routing to Contract Administrator for review prior to proceeding with work.

3.3 INSTALLATION OF HV TECK CABLES

.1 Utilize high voltage Contractors to provide cable and installation work. Installation of cables and terminations are to be made by personnel skilled in this type of work.

.2 Unless otherwise noted, install cable direct buried to the transformer and switchgear cabinets.

.3 Cable shall be protected by treated plank on sections with vehicular load as depicted in the Drawings.

.4 Cable shall be separated by treated planks when crossing over underground service utilities or pipes, using spacing in CSA 22.3 No.7 table 2. All crosses shall be performed in a perpendicular angle.

.5 Provide ancillary mounting hardware to provide a proper installation. Install cables in accordance with manufacturer's spacing criteria.

.6 Run and install cables and hardware in accordance with local electrical governing authority requirements and codes.

.7 Determine cable lengths with care using field measurements where possible so that wastage is kept to a minimum. Cable runs are to be continuous with no splicing.

.8 Ensure that each cable is continuous with no splices. Provide separate grounding conductors as required.

.9 Ground shielding is required at the supply end only, unless instructed otherwise and verified.

.10 Take necessary precautions in handling cable on reels, as well as when installing in conduit, to ensure that no damage will result. Pull cables in accordance with best Standard Practices, as recommended by cable manufacturer.

.11 Provide a cable support and pullbox in conduit where shown and/or required.

.12 Take necessary precautions when handling cable on reel to ensure that no damage results in uncoiling process. While cable is being pulled, inspect sheath for any visible cracks or other damage. Immediately stop pulling cables if damage is evident, and replace or repair cable immediately. When pulling, except for short runs, use a pulling eye attached directly to conductors that make up cable. Use CSA approved cable lubricants. When pulling cable, apply pulling tension to conductor not in sheath of cable. Cable pulling tension to be as recommended by cable manufacturer. Seal cable ends to prevent entrance of moisture.

.13 Handle and terminate cables and shielding with stress cones or other terminations as noted and to recommendations and instructions of cable manufacturer to suit application.

.14 Perform the following acceptance testing methods of cables before putting into service:

.1 AC Dielectric Withstand

.2 Insulation Resistance (Megger)

.3 Polarization Index

.4 Very Low Frequency (VLF)

.5 Dissipation factor (tan delta)

.15 Do not exceed IEEE/IEC guide and manufacturer's recommended test voltage or duration. Submit test report to the Contract Administrator for review and acceptance prior to energization.

3.4 COLOUR CODING AND TAGGING

.1 Color code all power distribution conductors at both ends throughout the Facility.

.2 Same color for same phase throughout, by insulation color markers.

.3 Conductor color coding to be in accordance with CEC and as follows:

3 Phase - red (A), black (B), blue (C)

.4 Identify all cables with the cable tag at all termination points and at all pull boxes. All cable markers must be readily visible when the device cover is open.

3.5 CLEANING

.1 Upon completion, remove surplus materials, rubbish, tools and equipment.

3.6 WARRANTY

.1 The Vendor shall provide a complete warranty for all equipment, labor and materials for the arresters valid for a period of 2 years from the date following Substantial Completion of the Winnipeg North Garage Replacement construction contract.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products and accessories.

.2 Submit samples of conductors, where requested in Contract Documents or when requested by Contract Administrator.

2 Products

2.1 GENERAL POWER CABLES

.1 CSA approved, ULC labelled and certified. Unless otherwise noted, conductors to be copper and be suitable for applications as noted in governing local electrical code.

.2 "RW90" CSA certified, single copper conductor to CSA C22.2 No. 38, 600/1000 volts, maximum 90°C (194°F) conductor temperature, -40°C (-40°F) minimum installation temperature, X-link polyethylene (XLPE) insulation, colour coded.

.3 "T90 Nylon", CSA certified, single copper conductor to CSA C22.2 No. 75, 600 volts, maximum 90°C (194°F) dry conductor temperature, -10°C (-14°F) minimum installation temperature, PVC insulated, nylon covered.

.4 "TWU" single copper conductor to CSA C22.2 No. 75, 600 volts, maximum 60°C (140°F) conductor temperature, -40°C (-40°F) minimum installation temperature, PVC insulated suitable for wet and buried installations, colour coded.

.5 "RWU90" CSA certified, single copper conductor to CSA C22.2 No. 38, 1000 volts, maximum 90°C (194°F) conductor temperature, -40°C (-40°F) minimum installation temperature, extra thickness X-link polyethylene (XLPE) insulation suitable for wet and buried installations, colour coded.

.6 Nexan DriveRX type cable for variable frequency drives: CSA approved to C22.2 no 123; flame, oil and UV resistant cable with copper conductors, corrugated continuous aluminum sheath and 3 bonding conductors; impact and crush resistant; temperature rating is 90°C to -40°C; 1000V 90C rated cross link polyethylene insulation; FT4 PVC jacket;

.7 Solid conductors to and including No. 10 AWG; stranded conductors in sizes larger than No. 10 AWG; branch circuit conductors constructed of 98% conductive copper; and approved for minimum 600 volts.

2.2 CONNECTORS

.1 General:

.1 materials: CSA approved and/or ULC listed and labelled as required by local governing authorities and codes;

.2 certification: CSA C22.2 No. 65;

.3 connectors marked with certification, manufacturer, manufacturer catalogue number and approval for conductor size and type.

.2 Armoured cable connectors of proper squeeze type connectors and plastic anti-short bushings at terminations.

.3 Connectors for conductors connecting to devices in accordance with local governing electrical requirements, equal to Ideal Industries No. 451, No. 452 and No. 453, "Wing-Nut", CSA certified, 600 volts rated, contoured wing design, fire retardant shell, twist on pressure type connectors.

.4 For conductors sized 3/0 and greater, provide long barrel double crimp, 2-hole compression type lug connectors, unless otherwise noted.

2.3 FIRE RATED CABLES

.1 nVent - Pyrotenax, model "System 1850", CSA certified, ULC listed and labelled, FM Specifications tested, 600 V, type "MI", 2-hour fire rated, copper sheathed, copper conductor, highly compressed magnesium oxide mineral insulated power cable. Connectors for copper-sheathed mineral conductors to be cable manufacturer's proper connectors and accessories as recommended by manufacturer to suit specific applications. Certified to C22.2 No. 124 and ULC Listed 2-hour fire-resistive cable tested to ULC-S139 fire test standards.

.2 nVent Pyrotenax, model "System 1850 Twisted Pair", CSA certified as FAS, FAS 90 and FAS 105 cable, ULC listed and labelled, 300 V, type "MI", 2-hour fire rated, copper sheathed, copper conductor, highly compressed magnesium oxide mineral insulated fire alarm and voice communication cable. Connectors for copper-sheathed mineral conductors to be cable manufacturer's proper connectors and accessories as recommended by manufacturer to suit specific applications. ULC Listed 2-hour fire-resistive cable tested to ULC-S139 fire test standards.

.3 Manufacturer's termination kits: Pyropak epoxy sealing compound kits and "Quick Term" connectors; connectors for MI conductors to be cable manufacturer's proper connectors and accessories as recommended by manufacturer to suit specific applications.

.4 Unistrut type C-channel supports, cable clips and straps as recommended by cable manufacturer to suit specific installation application. In applications of dissimilar materials, provide tape to insulate cabling and hardware.

.5 Brass plates for cable openings in ferrous metal enclosures.

.6 Include for required cable manufacturer's accessories and identification labelling.

.7 Include for manufacturer's authorized technician to perform initial coordination with and providing training to installing personnel on review of proper installation of cabling runs and termination of cabling. After completion of Work, manufacturer's technician to review installation work, test cabling and terminations and provide formal report of test results with observations, certification that installation work is complete and cabling with terminations perform as required, to satisfaction of cable manufacturer.

.8 Acceptable manufacturer of fire rated MI type cables is nVent.

2.4 STANDARD CONTROL AND COMMUNICATIONS CABLES

.1 Type LVT 300 V

.1 CSA approved, FT4 rated.

.2 Solid annealed copper conductors sized as indicated.

.3 Insulation: Polyethylene.

.4 Overall covering: PVC jackets.

.5 Where installed in plenums, cable to be certified to C22.2 No.214 and FT6 rated.

.2 Type TEW

.1 ULC listed and labelled, CSA certified to C22.2 No. 127.

.2 Solid copper wire rated for 600 volts, No. 18 AWG.

.3 Thermoplastic insulated with overall nylon jacket.

.4 105°C (220°F) conductor temperature.

.5 Complete with required number of copper conductors and colour coding.

.3 For interconnection of security system elements, including fire protective signaling devices and two-way emergency communication systems:

.1 Nexans, "Securex II", FAS 105, 300 volts, 105°C (220°F) conductor temperature rated fire alarm system flexible armoured cable with solid copper conductor, shielding, flame retardant PVC insulation and red colour outer overall jacket, ULC listed and labelled and CSA certified to C22.2 No. 208.

.2 When not run in conduit, include interlock aluminum or galvanized steel armour with overall jacket.

2.5 CONDUCTOR PULLING LUBRICANT

.1 IDI Electric, "Ideal Yellow 77" or "Wire Lube" as required.

2.6 TECK CABLES

.1 Nexans, "Firex II Teck" cables as follows:

.1 certified to CAN/CSA C22.2 No.131, Type TECK 90 Cable;

.2 rated for outdoor, weather resistant and wet locations including direct burial applications;

.3 1000 V rated;

.4 Conductor: Bare, Soft drawn, Class B Compact or Compressed Stranded Copper conductors per ASTM;

.5 insulation: chemically cross-linked thermosetting polyethylene (XLPE);

.6 bonding conductor (1/C Cable): Soft drawn bare copper;

.7 inner jacket: sunlight resistant PVC jacket tightly applied over assembly, to prevent slipping of core in a vertical position;

.8 armour: flexible interlocked aluminum armour, over inner jacket for mechanical protection;

.9 overall PVC jacket rated -40°C (-40°F);

.10 barrier tape over shield;

.11 terminations to suit specific applications.

.2 Acceptable manufacturers are:

.1 Nexans;

.2 Prysmian Cables (Pirelli);

.3 General Cable;

.4 Aetna Cables;

.5 Kerite Company;

.6 Texcan.

2.7 TRACER WIRE

.1 Tracer wire, also called locator wire, to be provided to assist in locating ducts, conduits, pipes and other lines after they have been buried underground.

.2 Standards:

.1 ULC listed and labelled.

.2 ASTM.

.3 ICEA/NEMA.

.4 Direct burial rated.

.3 Standard Tracer Wire: solid copper conductor insulated with high molecular weight polyethylene (HMWPE); manufactured according to ULC constructions in both 30 V and 600 V versions suitable for use at maximum continuous operating temperature of 75°C (167°F) in wet and dry locations.

.4 Tracer wire to be compatible for use and connection to industry standard frequency generator which is connected directly to cable to be traced, and high or low frequency signal is applied. In passive method, power voltages are sometimes applied at frequency of 50-60 Hz.

.5 Connectors to be moisture displacement connectors as recommended by wire manufacturer to suit applications. Connectors equivalent to Copperhead SnakeBite or 3M DBR series.

.6 Typically, size no.14 AWG for installation in open trench; no. 2 AWG typically in conjunction with trenching machine; for directional boring applications, minimum no.10 AWG. Comply with manufacturer’s recommendations.

.7 Jacket colour: unless otherwise required by local governing authority or code, or by The City, and reviewed with Contract Administrator, provide jacket colour for applications as follows:

.1 Electrical - red;

.2 Gas - yellow;

.3 Communication - orange;

.4 Potable Water - blue;

.5 Sewer - green.

.8 Include for after installation inspection and testing. Refer to Part 3 for additional requirements.

3 Execution

3.1 PROJECT CONDITIONS

.1 If identified in documents, verify that field measurements and conditions are as identified.

.2 Unless specifically noted, cable routing on drawings is schematic and approximate and not reflective of elevations. Route cable as required to meet project conditions. Determine exact routing and lengths on site.

.3 Confirm fire protection ratings of construction to ensure that rooms and paths of conductors are fire rated in accordance with local governing codes requirements. Include fire rated conductors as required to meet local governing codes requirements.

3.2 CO-ORDINATION

.1 Co-ordinate work with work provided under other electrical work and work of other trades.

.2 Determine required separation between cable and other work.

.3 Determine cable routing to avoid interference with other work.

.4 Submit any alternative cable routing to Contract Administrator for review prior to proceeding with work.

3.3 INSTALLATION OF CONDUCTORS

.1 Provide required conductors. Provide fire rated conductors for applications as required by local governing codes and standards, and requirements of local governing authorities.

.2 In applications where, multiple conductors in conduit are being run, provide trapeze configuration of Unistrut type metal C-channels and threaded rod hangers to support cable/conduit from ceiling slab. Wall mounted cable/conduit brackets and ring type conduit hangers may be permitted in applications approved by The City and reviewed with Contract Administrator. Provide required cable support system accessories which are not specified herein or shown on drawings but are required for proper installation.

.3 Conductors, unless otherwise noted, to be as follows:

.1 underground inside or outside building and for non-climate-controlled areas - "TWU" or "RWU90";

.2 for connections to electric heating coils in supply air ductwork systems, and for connections to other electric heating equipment where use of 90 degrees C. rated conductors are recommended by heating equipment manufacturer - "RW90";

.3 for conductors requiring fire rating by current regulations and local codes including feeders for emergency systems, fire fighter's elevators, fire alarm systems, other life safety systems and for applicable signal and control circuits of these systems - type "MI" CSA approved, ULC listed and labelled, 2-hour fire rated, copper sheathed mineral insulated copper conductors;

.4 climate controlled areas branch circuit wiring in accessible ceiling spaces and within stud wall construction consisting of drops down to luminaries and drops down stud walls to devices and in furniture systems - "AC90" flexible armoured cable ("BX") (maximum 6 m (20') run permitted);

.5 for connections to variable speed drives: Nexan DriveRX type cable for variable frequency drives as recommended by drive manufacturers;

.6 for climate-controlled areas wiring except as noted above or specified elsewhere in Specification or as noted on drawings - "T90 Nylon" or "RW90".

.4 Support flexible armoured cable in ceiling spaces and in stud wall construction with steel 2 holes cable straps to "Code" requirements. Run flexible armoured cables in neat manner parallel to building lines. Utilize centralized conduit runs to maintain maximum permitted runs of flexible armoured cables as recommended by cable manufacturer and as required by local governing codes. Provide insulating grommet at cut ends of flexible armoured cable to protect conductor insulation.

.5 Coordinating with other trades, install control wiring as required or as indicated. Confirm exact type of control wiring with manufacturers of equipment/systems being interconnected, and as required by local governing electrical code. Provide required fire alarm cables for fire alarm system applications or security system applications as recommended by fire alarm system manufacturer, complying with requirements of local governing code and local governing authorities. Typically run control wiring in conduit. Conductors not installed in conduit or raceways to be fire insulated rated in accordance with latest governing code flame spread ratings requirements, and suitably mechanically protected by means acceptable to The City and reviewed with Contract Administrator. Ensure that conductors comply with fire rating - FT6 rating requirements when run in plenums and similar construction.

.6 Coordinate responsibility for provision of control wiring for Mechanical Division equipment and equipment of other Divisions, with respective Divisions of the Work.

.7 Generally, conductor sizes are indicated on drawings. Such sizes are minimum requirements and must be increased, where required, to suit length of run and voltage drop in accordance with local governing electrical code or obtained from Contract Administrator. Conductors not sized or specified of type, to be sized and of type in accordance with requirements of local governing electrical code.

.8 Do not use conductors smaller than No. 12 AWG in systems over 30 volts, unless otherwise noted. Do not use conductors smaller than No. 6 AWG for exterior luminaire wiring unless otherwise noted.

.9 Colour code conductors throughout to identify phases, neutrals and ground by means of self-laminating coloured tape, coloured conductor insulation, or properly secured coloured plastic discs. Colours, unless otherwise noted, to be as follows:

.1 Phase A - red;

.2 Phase B - black;

.3 Phase C - blue;

.4 Ground - green;

.5 Neutral - white;

.6 Control - orange.

.10 When pulling wires into conduit use lubricant and ensure that wires are kept straight and are not twisted or abraised.

.11 Control conductors, in addition, to be numbered with Brady Ltd. or Electrovert Ltd. Z type markers.

.12 Colour code conductors for communications systems in accordance with system component manufacturer's recommendations.

.13 Neatly secure exposed wire in apparatus enclosures with approved supports or ties.

.14 Install low voltage conductors in conduits, unless otherwise noted within Documents.

3.4 INSTALLATION OF FIRE RATED CONDUCTORS

.1 Obtain from local governing electrical authority, approval of proposed fire rated cable to be installed.

.2 Obtain installation and testing training from cable manufacturer as required for specific cabling type. Installation to be performed by personnel experienced in installation of specific cabling.

.3 Submit with shop drawings, copy of manufacturer's detailed installation manual and testing procedures. Provide 2-hour fire rated type, CSA approved, ULC listed and labelled, copper conductors for following:

.1 conductors to fire-fighter elevators;

.2 conductors to fire pumps and sprinkler pumps;

.3 conductors to smoke venting fans;

.4 conductors to emergency lighting panel boards;

.5 conductors to fire alarm control panels and transponders;

.6 fire alarm conductors risers;

.7 conductors as required by Code requirements;

.8 fire alarm system feeders as shown interconnecting existing fire alarm system and additional system;

.9 applicable local governing code required applications for control and signalling conductor circuits of and between life safety equipment and systems;

.10 conductors as noted on drawings.

.4 Provide fire rated type cabling for specific conductors as noted and as required for specific applications by local governing codes. Install fire rated type conductors for applications noted above and as shown on drawings in strict accordance with the manufacturer's instructions and recommendations. Installation must be in a neat and professional manner as per manufacturer's approval. Make arrangements for manufacturer's technician to provide onsite services as specified. Conductors not sized on drawings, to be sized in accordance with requirements of local electrical code.

.5 Provide Unistrut C-channels, clips, wall brackets, etc., as required and as recommended by cable manufacturer to suit the on-site installation conditions. Provide system of Unistrut type C-channel hangers and rods spaced at minimum 1.2 m (4') but which must be confirmed with cable manufacturer, for running of cables. Where clips and other hardware are in contact with cables, insulate cables/hardware with suitable tape as per cable manufacturer's recommendations for applications of dissimilar metals.

.6 Make terminations of conductors with manufacturer's approved components and connectors in accordance with manufacturer's recommendations. Obtain proper tools for cable terminals from the cable manufacturer. Terminations must be completed immediately once started to avoid moisture ingress from the surrounding air. Connections to ferrous cabinets for single conductor cables shall incorporate brass plates sized as required and as per cable manufacturer's requirements. Brass plates shall be complete with required drilled and tapped holes. Cable lugs to be temperature rated as per manufacturer's instructions.

.7 Splicing of cables is not permitted.

.8 When pulling cable, apply pulling tension to the conductor not in sheath of cable. Limit cable pulling tension to as recommended by cable manufacturer.

.9 Terminate cable in equipment with termination kits as per cable manufacturer's instructions.

.10 Terminations to be witnessed by manufacturers authorized technician. Perform terminations in accordance with cable manufacturer's instructions.

.11 Terminate cables to transformers, motors and other vibrating equipment by use of means to isolate vibration in accordance with cable manufacturer's recommendations.

.12 Ground cabling as per cable manufacturer's instructions and as per local governing electrical code requirements.

.13 Take necessary precautions when handling cable on reel to ensure that no damage will result in the uncoiling process.

.14 Where cables penetrate fire rated construction, provide ULC listed and labelled, fire stopping and smoke seal materials or fittings to protect integrity of fire rated construction. Install work in compliance with ULC standards and where required by local governing codes, provide tray type suitable for plenum environments.

.15 Engage with cable manufacturer to test cables and terminations after installation, in strict accordance with cable manufacturer's recommendations. Megger terminations to check that insulation resistance is acceptable to cable manufacturer. Prior to completing each termination, test insulation resistance and follow cable manufacturer's procedures until resistance reaches cable manufacturer's listed acceptable level.

.16 Include and arrange for cable manufacturer's authorized representative to review installation and associated work and testing of installed cables. Prepare report consisting of test sheets with results of cables tested and a certificate of verification signed by testing engineer/technician. Report to include copy of cable manufacturer's signed inspection letter validating test results and documenting that work was performed to satisfaction of manufacturer. Submit minimum one hard copy and electronic copy to Contract Administrator.

3.5 INSTALLATION OF TECK CABLES

.1 Provide cables as required for specific applications. Handle, install, and terminate in accordance with manufacturer's recommendations and instructions and as herein specified.

.2 When pulling cable, apply pulling tension to conductor not in sheath of cable. Limit cable pulling tension to as recommended by cable manufacturer.

.3 Terminate cable in equipment with lugs and termination kits as per cable manufacturer's instructions.

.4 Installation of cable splices and terminations to be made by personnel skilled in this type of work.

.5 Ground shielding as per cable manufacturer's instructions.

.6 Take necessary precautions when handling cable on reel to ensure that no damage will result in uncoiling process.

.7 No splices are allowed unless justified by cable pulling tension calculations and approved in writing by The City and reviewed with Contract Administrator. Where splices are permitted, locate in area accessible. Review locations of splices with Contract Administrator, prior to start of Work.

3.6 INSTALLATION OF TRACER WIRE

.1 Install tracer wire in accordance with wire manufacturer's recommendations for specific applications.

.2 Connect with proper connectors to protect from moisture and corrosion. Do not twist wires together and wrap with electrical tape.

.3 Place tracer wire in same orientation to installed pipe. Using spacer, tape tracer wire to pipe every 2.4 m to 3 m (8 to 10 feet) in three o'clock position or provide fill between pipe and tracer wire. Install colour coded warning tape minimum 300 mm (1') above pipe.

.4 Bring tracer wire above ground for ease of terminating signal and terminate in test station.

.5 Ground ends or wire.

.6 After installation is complete, perform conductivity test or locate test and demonstrate to Contract Administrator and The City.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Specific reference is made to the following sections:

.1 Section 01 33 00, Submittal Procedures

.2 Section 26 05 00, Basic Electrical Materials and Methods

1.2 CODES AND STANDARDS

.1 CSA C22.1 Canadian Electrical Code, Part 1

.2 IEEE 837 Standard for Qualifying Permanent Connections Used on Substation Grounding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Quality assurance submittals: provide in accordance with Section 01 45 00 - Quality Control.

.1 Manufacturer's Instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address,

.3 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with manufacturer’s recommendations in clean, dry and well-ventilated area.

.2 Store and protect the cables from nicks, scratches and blemishes.

.3 Replace defective or damaged materials with new.

2 Products

2.1 MATERIALS

.1 Rod electrodes: copper clad steel, 19 mm diameter by 3 m long.

.2 Conductors: bare, stranded, tinned soft annealed copper wire, size No. 4/0 AWG and 2/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, fence ground connections.

.3 Conductors: No. 3/0 AWG extra flexible (425 strands) copper conductor for connection of switch mechanism operating rod to gradient control mat, fence gates.

.4 Bolted removable test links.

.5 Gradient control mat: copper, size 1219mm x 1829mm, 300 x 300 mm mesh.

.6 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Bonding jumpers, straps.

.5 Pressure wire connectors.

.7 Wire connectors and terminations: as indicated.

3 Execution

3.1 INSTALLATION

.1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors during and after construction.

.4 Make buried connections, and connections to electrodes, structural steel work, using permanent mechanical connectors to IEEE 837.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Use No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0 AWG bare copper cable for taps on risers from main ground bus to equipment unless otherwise noted.

.7 Do not use bare copper conductors near un-jacketed lead sheath cables.

3.2 ELECTRODE INSTALLATION

.1 Install ground rod electrodes. Make grounding connections to station equipment.

.2 Install ground rod electrodes at the substation and switchgear locations as depicted in the Drawings.

.3 Install gradient control mat. Connect mat to station ground grid and switch mechanism operating rods.

.4 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

3.3 EQUIPMENT GROUNDING

.1 Install grounding connections as indicated.

.2 Ground non-current carrying parts of: transformers, switchgear, circuit breakers, frames of gang-operated switches, fuse bases, cable sheaths, raceways, pipe work, screen guards, switchboards, meter and relay cases. Any exposed building metal, within or forming part of station enclosure: Sub-station fences, steel structure, pothead bodies, outdoor lighting.

.3 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.

3.4 NEUTRAL GROUNDING

.1 Ensure transformer secondary neutral bushing is connected directly to neutral grounding resistor terminal using insulated cable.

.2 The neutral grounding resistor ground terminal shall be connected to the substation ground grid.

3.5 POLE MOUNTED SWITCHING DEVICE GROUNDING

.1 Interconnect ground riser with No. 4/0 AWG stranded annealed copper conductor and join to switch operating handle ground wires.

.2 Connect operating handle of switch to handle base with No. 3/0 AWG extra flexible copper conductor.

3.6 FIELD QUALITY CONTROL

.1 Perform ground continuity and integrity testing to ensure the ground grid system installation is satisfactory.

.2 Engage testing agent to inspect grounding and perform ground resistance test. Submit test results to the Contract Administrator for review and acceptance before backfill.

.3 Provide step-and-touch potential calculations using measured station ground resistance measurements. Submit test result and inspection certificate before energizing electrical system.

3.7 CLEANING

.1 Upon completion, remove surplus materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 REFERENCES

.1 Winnipeg Electrical By-law

.2 Manitoba Electrical Code (MEC)

.3 ANSI/IEEE 837-1988, Qualifying Permanent Connections Used in Substation Grounding.

.4 CSA Z32.1-M1986, Safety in Anaesthetizing Locations.

2 Products

2.1 EQUIPMENT

.1 Cable trays shall be suitable for use as equipment grounding conductors in accordance with the requirements of OESC, but grounding conductors shall be installed with cable trays as shown on the Contract Drawings.

.2 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.3 Copper conductor: minimum 6 m (20') long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size 4/0 AWG or as indicated in the Contract Documents.

.4 Grounding conductors: bare stranded copper, tinned, soft annealed, size 4/0 AWG or as indicated.

.5 Insulated grounding conductors: green, type RW90.

.6 Ground bus: copper, size 6mmX50mm or as indicated in contract drawings, complete with insulated supports, fastenings, connectors.

.7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

3 Execution

3.1 INSTALLATION GENERAL

.1 Electrical material and equipment shall be transported within the site, unloaded, uncrated, handled, stored, installed (including assembly of all component parts), and wired in accordance with the manufacturer's instructions and recommendations and the requirements specified herein.

.2 All electrical equipment such as switchgear, generators, motors, neutral points of transformers, panels, cabinets, wiring devices, metallic raceways, armor, lighting fixtures, boxes, building structures, lightning protective apparatus, fences and gates, railroad tracks, manhole ladders and racks, and other equipment as specified on the Contract Drawings or as directed by The City, shall be grounded by Contractor in accordance with the requirements of this Specification and the Contract Drawings.

.3 All medium voltage, low voltage integral horsepower and fractional horsepower motors (including motors remote from the ground grid) shall be grounded in accordance with the methods shown on the Contract Drawings.

.4 All conduit runs shall be grounded at enclosures of electrical distribution or control equipment at which they originate. Grounding of the cable tray systems shall be accomplished using a bare stranded copper cable attached to the outside of one vertical side of each tray. Each cable tray shall be grounded as per the OESC.

.5 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.6 Install separate ground conductor in all conduits sized to Electrical Code unless noted otherwise.

.7 Install connectors in accordance with manufacturer's instructions.

.8 Exposed grounding conductors shall be run to conform to the surface over which they pass. Diagonal runs shall be avoided; the runs shall be horizontal, vertical, and parallel to building walls or columns. Conductors shall be neatly and securely fastened to the mounting surface without slack using galvanized malleable iron straps or clamps. Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.9 Connections of ground conductors to equipment shall be by means of a lug which shall be compressed on the cable end. The lug shall be bolted to the equipment frame using holes or terminals provided by the equipment manufacturer for this purpose. Where no such provisions are made, Contractor shall drill holes in locations designated by The City. Holddown bolts shall not be used for ground connections. Ground connections to motors shall be bolted directly to motor frame and not to sole plates or supporting structures. At all bolted connections, the joining surfaces shall be scraped clean and coated with No-Ox-Id as manufactured by Sanchem, Inc. or approved equal compound. Soldered joints not permitted.

.10 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.11 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.12 Install separate ground conductor to outdoor lighting standards.

.13 Install grounding resistance bank if required by contract drawings.

.14 Connect building structural steel and metal siding to ground as per the Electrical Code or specified in contract drawings

.15 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.16 Bond single conductor, metallic armored cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.17 Ground secondary service pedestals.

3.2 MANHOLES

.1 Install conveniently located grounding stud, electrode, size 4/0AWG stranded copper conductor in each manhole.

.2 Install ground rod in each manhole so that top projects through bottom of manhole. Provide with lug to which grounding connection can be made.

.3 Ground metallic frames and covers of manholes and handholes in accordance with OESC requirements.

3.3 BUILDING ELECTRODES

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.

.2 Install water meter shunt.

.3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.

.4 Install rod electrodes and make grounding connections as required by the OESC or specified in contract drawings

.5 Bond separate, multiple electrodes together.

.6 Use size 4/0 AWG copper conductors for connections to electrodes.

3.4 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of primary 600 V system, secondary 120V system.

3.5 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.6 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.

.2 Sound, fire alarm, intercommunication systems as indicated.

.3 The shields of shielded instrumentation cable shall be grounded in accordance with the Contract Drawings. Shield braids shall be taped or insulated with sleeves to prevent accidental grounding of shields. All twisted pairs, triplets, or quads cables will have an overall jacket to prevent field grounding.

3.7 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results – Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the Contract Administrator and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

2 Products

2.1 DUCT FOR CONCRETE ENCASEMENT

.1 DB/2 PVC, CSA Certified, tested to CSA Standard C22.2 No. 211.1.

.2 Conduit to be suitable for concrete encasement and in accordance with applicable local electrical utility requirements.

.3 Synthetic polypropylene fibre (plastic) twine cord or 19 mm (3/4") diameter polyethylene rope, approved by local governing Utility.

2.2 TRANSFORMER PAD

.1 Precast concrete transformer pad, as required to accommodate transformer and generally as follows:

.1 consisting of precast concrete top cover and foundation;

.2 sized as per transformer requirements and as per local governing electrical Utility details;

.3 concrete of minimum strength of 32 MPa (4600 psi) which shall be confirmed with transformer manufacturer;

.4 steel reinforced;

.5 lifting holes;

.6 top cover openings coordinated with final design of transformer as approved by local governing electrical Utility;

.7 foundation cable openings coordinated with duct bank entry;

.8 duct drainage to suit designed sloping of ducts;

.9 suitable drainage provisions consisting of sump pit, or duct opening in bottom for connection of drainage ducts, as indicated and as reviewed with Contract Administrator.

.2 Confirm and coordinate exact requirements with transformer requirements and local governing electrical utility.

.3 Acceptable manufacturers subject to approval by local governing electrical utility:

.1 Armtec Ltd (Brooklin Concrete);

.2 Industrial Cast Stone Ltd.;

.3 Utility Structures Inc.;

.4 Hanson Pipe and Pre-cast.

2.3 IN GROUND HANDHOLES AND PULL BOXES

.1 Fully weatherproof, watertight and corrosion resistant types for splices, pulls and junction applications:

.1 Cast-in-place concrete.

.2 Pre-cast concrete.

.3 Pre-fabricated made of semi-concrete or non-concrete materials polymer concrete.

.2 CSA approved and in accordance with following, as applicable:

.1 OPSS 602;

.2 ASTM C857;

.3 ANSI/SCTE 77;

.4 Local governing authority requirements.

.3 Concrete to be in accordance with CSA A23.1 and CSA A23.2. Minimum compressive strength to be of 32 MPa (4600 psi), 6-8% air entrainment, and be suitable for installation and use through a temperature range of minus 40°C to 70°C. (-40°F to 158°F).

.4 Polymer concrete to consist of aggregates in combination with polymer resin, and reinforced with fibreglass. Non-conductive and non-flammable. Stable under freeze / thaw conditions.

.5 Include required drainage provisions consisting of sump pit or duct opening in bottom for connection to drainage ducts, as indicated and as reviewed with Contract Administrator.

.6 Enclosures to be designed and installed to withstand loads likely to be imposed and be of size, with wiring/duct entries, covers and bottoms (as noted) and of type to suit specific applications.

.7 Steel Covers:

.1 Galvanized steel according to CAN/CSA-G40.20/G40.21 and CAN/CSA-G164M92.

.2 Checker tread on top side for skid resistance.

.3 Tamper-proof, stainless steel head bolts recessed into cover.

.4 Area for logo.

.5 Flush mounted with gaskets to prevent ingress of water.

.6 No protrusions extending out from top of cover; no tripping hazards.

.7 Minimum thickness of cover is 10 mm (3/8").

.8 Cable termination hardware to accommodate cables and required grounding hardware. Hardware to be corrosion resistant and in accordance with code requirements.

.9 Provide PVC seals on cable entry openings.

.10 Identification:

.1 Identification engraving / warning signage, weather and corrosion resistant.

.2 Identification markings on each box embedded on outside vertical surface of box, showing manufacturer's name or trademark, and date of manufacture.

.3 Top surface of cover permanently marked, showing manufacturer's name or trademark, and date of manufacture; this marking embedded into top surface of cover, or embedded into a corrosion-resistant metal plate securely cemented to top surface of cover.

.11 Refer to drawings for dimensions.

.12 Acceptable manufacturers are:

.1 Armtec Ltd (Brooklin Concrete);

.2 Industrial Cast Stone Ltd.;

.3 Utility Structures Inc.;

.4 Hanson Pipe and Pre-cast;

.5 Hubbell.

2.4 MANHOLES

.1 Manholes to be provided for concrete encased ductbank runs. Provide manholes complete with cast iron covers and collars/frames, ladders, cable pulling eyes, cable management trays, etc. Sizing and locations to suit design requirements and applications. Work to comply with local governing electrical utility requirements, specifications, and details on drawings.

.2 Comply with CSA/CAN A23.1 and 23.4 requirements and other required CSA Standards.

.3 Precast or cast in place concrete manholes to generally be as follows:

.1 sized as per drawing detail;

.2 concrete of minimum strength of 32 MPa (4600 psi) at 28 days (6-8%) which is to suit specific applications and code requirements;

.3 steel reinforced;

.4 cable openings coordinated with duct bank entry.

.4 Provide accessories as follows:

.1 minimum 800 mm (32") diameter, minimum 10 mm (3/8") thick, flush mounted cast iron cover with warning text on cover; review nomenclature with Contract Administrator prior to ordering; covers to have no protrusions from top that may be tripping hazard; covers to have skid resistant surface; covers to include tamper proof corrosion resistant cover bolts with suitable lifting provisions;

.2 minimum 150 mm (6") thick cast iron frame;

.3 concrete levelling collars;

.4 aluminum access ladders;

.5 galvanized steel cable pulling eye loops;

.6 galvanized steel cable racks and trays;

.7 structural lifting hooks on pre-cast units;

.8 drainage: storm sewer connection with cast iron service saddle with oil resistant gasket, stainless steel clamp and oil resistant O ring;

.5 Exact drainage requirements to be as coordinated with Contractor and/or Mechanical Contractor to suit project design requirements and onsite provisions.

.6 Acceptable manufacturers are:

.1 Armtec Ltd (Brooklin Concrete);

.2 Industrial Cast Stone Ltd.;

.3 Utility Structures Inc.;

.4 Hanson Pipe and Pre-cast.

3 Execution

3.1 INSTALLATION OF DUCT FOR CONCRETE ENCASED DUCTBANK

.1 Provide ducts and concrete encasement shown and as required, in accordance with applicable local governing authority codes and standards. Coordinate Work with trades responsible for performing excavation, backfill, and concrete Work. Confirm requirements with local authority having jurisdiction. Refer to Section entitled Basic Electrical Materials and Methods for excavation, concrete, and backfilling work requirements.

.2 Use standard duct lengths and fittings as much as possible and practicable. When cutting is necessary, carefully taper duct ends with special field tapering machine. Make joints by means of standard couplings. Maintain minimum bending radius of 1 m (3.3').

.3 Make concrete encased duct joints with use of couplings which provide a smooth water tight joint between ducts, using suitable cement that is specifically designed for use with duct pipe being used.

.4 Separate ducts by means of plastic 75 mm (3") spacers and placed 75 mm (3") away from wooden forms on both sides ensuring that there is 75 mm (3") of concrete between ducts and a 75 mm (3") concrete envelope around duct assembly. Elevations and slopes of ducts to be as shown on drawings and as required, or based on minimum 760 mm (30") below finished grade and minimum 1% slope. Separate ducts with spacers at distance as required by local authority and as per duct manufacturers' instructions. Do not locate spacers of vertical rows of ducts directly above each other. Maintain minimum 150 mm (6") separation. Where ducts cross roads, paved areas, disturbed ground, new or future, concrete envelope to have 15 mm (5/8") diameter reinforcing steel bars laid longitudinally along trench with 100 mm (4") lateral spacing and 50 mm (2") above base of concrete. Provide an overlap of 600 mm (2') on reinforcing bars, where necessary. Extend reinforcing 1.5 m (5') beyond backfilled areas, driveways, roadways etc. Reinforce duct runs at all building entries for a distance of 1.5 m (5') out from such entry walls, bars being embedded in walls.

.5 Do not place concrete around ducts, and do not backfill until duct line is inspected and reviewed with Contract Administrator and local governing authority. If concrete is poured around ducts or if trenches are backfilled before ducts have been reviewed, be responsible for removing and replacing concrete at no extra cost to allow for approval inspections.

.6 When conduit has been laid and duct banks work completed and set, draw a steel test mandrel through each duct in presence of Contract Administrator. Diameter of mandrel to be 13 mm (1/2") less than inside diameter of duct. Remove obstruction found in duct to satisfaction of Contract Administrator, and leave duct system completely clear. No conduit will be accepted as being ready for installation of feeders until this is done.

.7 Whenever Work is suspended, protect ends of ducts by means of suitable plugs and leave such plugs in use as long as may be necessary. When conduit is installed for future extension, plug ducts and end of duct bank boxes for protection.

.8 Do not lay defective ducts under any circumstances.

.9 Include for provision of following requirements:

.1 concrete used for encasing ducts to have a minimum compressive strength of 20.7 mPa (3000 psi);

.2 compact and cover bottom of trench with a freshly poured concrete bed 75 mm (3") thick, for full width of trench;

.3 lay lowest row of ducts on concrete bed, completely enclosed in concrete; install subsequent layers in a similar manner; space ducts 150 mm (6") centre to centre both vertically and horizontally unless indicated otherwise; fill spaces between ducts with concrete;

.4 enclose ducts in a minimum 75 mm (3") thick envelope of concrete for full width of trench;

.5 fill entire space between ducts with concrete; do not use concrete which has started to set to a point that it will not properly pour to smoothly fill spaces between and around ducts;

.6 use of monolithic method (i.e. placing all ducts and pouring concrete around complete installation) is subject to approval of local governing authority and review with Contract Administrator;

.7 exercise with care when placing concrete around ducts to ensure that ducts remain in correct position with proper spacing and that no concrete enters any of ducts;

.8 reinforce duct where duct crosses filled or disturbed ground;

.9 there must be no metallic reinforcing rods or other conducting material encircling a single conduit in a duct bank (entire duct bank may be encircled);

.10 maximum size of aggregate in concrete to be 10 mm (3/8");

.11 provide reinforcing rods and dowels in ductbank at building wall as detailed;

.12 provide sloping and drainage of ducts to prevent pooling of water within ducts; review requirements with Contract Administrator prior to start of Work;

.13 unless drainage provisions have been provided within building for duct draining, seal openings where ducts enter building with elastomeric, fire rated, waterproof sealing material to prevent egress of water and that can easily be removed for access to ducts;

.14 provide marking tape and marking pavers as required by local governing authorities;

.15 provide one (1) continuous length of polyethylene rope or Brantford twine in each duct indicated as spare or for future use.

.10 Allow Contract Administrator and local authority representative (as applicable) access and opportunity to witness Work, prior to covering.

.11 Refer to requirements of drawing detail.

3.2 INSTALLATION OF TRANSFORMER PAD

.1 Provide specified transformer pad and foundation in accordance with local governing electrical utility's requirements, in location as shown and as detailed on drawings. Coordinate required excavation, backfill, and concrete work. Refer to Section entitled Basic Electrical Materials and Methods for excavation, concrete, and backfilling work requirements. Arrange and coordinate work to prepare ground to provide a level and good draining foundation for pad and transformer. Coordinate cable entry opening with location of duct bank.

.2 Installation to be in accordance with local governing electrical Utility's requirements and with generally accepted trade practices. Exact requirements to be confirmed with local governing electrical Utility.

.3 Provide duct drainage as required.

.4 Provide guard posts as required.

.5 Provide grounding as required by local governing electrical authority. Also refer to requirements of Section entitled Grounding and Bonding.

.6 Perform work under general supervision of Contractor.

3.3 INSTALLATION OF HANDHOLES/JUNCTION BOXES

.1 Coordinate installation work with trades responsible for excavation and backfilling work.

.2 Install handholes/boxes plumb, true to alignment and grade, and firmly bedded on drainage pocket backfill.

.3 During installation, duct entry holes to be oriented in required direction. Enlarging of duct entry holes is prohibited.

.4 Coordinate connection of ducts to ensure that proper sloping is maintained to suit designed elevations and slope of duct run and required drainage.

.5 Refer to drawing detail for additional requirements.

.6 Comply with grounding and bonding requirements of local governing electrical codes and authorities.

.7 Confirm drainage provisions and provide as required. Coordinate work with Contractor to connect drains.

.8 Obtain required approvals of work from local governing electrical utility and review with Contract Administrator prior to back filling and covering.

.9 Refer to Section entitled Basic Electrical Materials and Methods for excavation, concrete, and backfilling work requirements.

3.4 INSTALLATION OF MANHOLES

.1 Provide specified manholes. Coordinate required excavation, backfill, and concrete work. Arrange and coordinate work to prepare ground to provide a level and good draining foundation for manholes. Coordinate cable entry opening with location of duct bank.

.2 Installation to be in accordance with local governing electrical utility's requirements and with generally accepted trade practices. Confirm exact requirements with local governing electrical utility.

.3 Provide grade levelling collars/neck such that cover is flush with finished grade in paved areas and 38 mm (1-1/2") above grade in unpaved areas. Provide extension collars as required. Confirm final grade level with Contractor.

.4 Confirm drainage provisions and provide as required. Coordinate work with Contractor to connect drains.

.5 Coordinate connection of ducts and duct bank to ensure that proper sloping is maintained to suit designed elevations and slope of duct bank and required drainage.

.6 Comply with grounding and bonding requirements of local governing electrical codes and authorities.

.7 Work to be performed under general supervision of Contractor.

.8 Obtain required approvals of work from local governing electrical utility and review with Contract Administrator prior to back filling and covering.

.9 Refer to Section entitled Basic Electrical Materials and Methods for excavation, concrete and backfilling work requirements.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit product data and shop drawings for following:

.1 cable tray with copy of ULC certificate and/or proof of CSA approvals;

.2 cable duct with copy of ULC certificate and/or proof of CSA approvals;

.3 copy of installers' training certificate from manufacturer.

.2 Submit detail drawings of proposed routing and dimensions.

2 Products

2.1 BASKET CABLE TRAY

.1 Legrand-Cablofil, CSA approved and labelled, or ULC listed, basket type cable tray system complete with factory made couplers, fittings, tee sections, elbows, universal dropouts, etc., and required supporting and installation accessories. Features include but are not limited to following:

.1 minimum 300 mm x 100 mm (12" x 4") unless otherwise noted on drawings;

.2 welded wire construction of minimum 5 mm (0.197") diameter carbon steel wires and hardware, conforming to requirements of ASTM A510 Grade 1008 with black powder coated finish paint to ASTM D 3451;

.3 welded wire construction of minimum 5 mm (0.196") diameter stainless steel wires and hardware, conforming to requirements of AISI Type 304L cleaned and passivated to ASTM A 380;

.4 continuous, rigid, welded steel wire mesh cable tray system;

.5 top wire safety edge;

.6 wire mesh welded at intersections;

.7 mesh sections having minimum one bottom longitudinal wire along entire length;

.8 warning signs;

.9 accessories included as required.

.2 Prior to start of work, prepare and submit detailed installation drawings, including plans, elevations and sections of proposed tray and routing. Coordinate such drawings with coordination drawings of trades. Include for design calculations to determine load limitations.

.3 Tray to not have sharp edges that may damage cables during running of cables. Final finish to be smooth with no burrs that may damage cables.

.4 Use manufacturer's trained and certified installers to perform work. Use tools as recommended by and supplied by tray manufacturer. Utilize manufacturer's supplied cutter for cutting tray. Submit with shop drawings, copies of installing technicians' certificates of training on respective tray systems.

.5 Provide support of a trapeze configuration containing horizontal hanger brackets and vertical threaded rods on each side. Secure rods to brackets as per system manufacturer's instructions. Space supports at maximum 1.5 m (5'), to provide support of loads up to 53 kg/m (36 lbs per foot).

.6 Provide support of a center hanging configuration containing horizontal hanger brackets and vertical threaded PVC insulated rods in middle. Secure rods to brackets as per system manufacturer's instructions. Space supports at maximum 1.5 m (5'), to provide support of loads up to 53 kg/m (36 lbs per foot).

.7 Where cable tray penetrates fire rated construction, provide ULC listed and labelled, fire stopping and smoke seal materials or fittings to protect integrity of fire rated construction. Install work in compliance with ULC standards and where required by local governing codes, provide suitable for plenum environments.

.8 Provide tray complete with manufacturer's pre-manufactured accessories including but not limited to:

.1 splices, tee sections, elbows and braces to join and run tray in required configurations;

.2 cable exits and dropouts as required to protect cables when entering and exiting tray;

.3 conduit attachment fittings and clamps as required to connect conduits to tray;

.4 grounding/bonding hardware provisions to maintain ground continuity;

.5 dividers to separate various system cabling to degree reviewed with Contract Administrator, but typically two dividers in 300 mm (12") wide tray;

.6 cable installation rollers for pulling cables safely into tray;

.7 mounting brackets, supports and seismic restraints to suit specific applications;

.8 top covers and bottom inserts to protect cables, as required

.9 System accessories matching construction material of tray, to be supplied by system manufacturer to suit specific applications.

.10 Manufacturer to provide installer with required certified training of installation of tray system.

.11 Acceptable manufacturers are:

.1 Legrand-Cablofil;

.2 Eaton "Flextray";

.3 Canadian Electrical Raceways;

.4 Hubbell;

.5 WBT.

2.2 LADDER CABLE TRAY

.1 Thomas & Betts, CSA approved and labelled, ladder type cable tray as follows:

.1 in compliance with CSA C22.2 No. 126.1 and NEMA VE1;

.2 sized generally 300 mm W x 100 mm D (12" x 4") unless otherwise noted on drawings;

.3 side rails and rungs constructed of pre-galvanized steel conforming to requirements of ASTM A653 with G90 coating thickness;

.4 side rails and rungs constructed of stainless steel wires and hardware, conforming to requirements of AISI Type 304L;

.5 side rails reinforced with flanges;

.6 maximum 150 mm (6") rung spacing and supplied in 3 m (10') lengths;

.7 rated for minimum CSA load D unless otherwise noted on drawings; cable tray to meet required NEMA/CSA load ratings with safety factor of 1.5 and also be able to support a 90 kg (200 lb) concentrated load at midspan over and above cable load;

.8 refer to drawings for approximate tray routings and lengths.

.2 Accessories:

.1 Factory made conduit connectors, couplers, fittings, tee sections, elbows, universal dropouts.

.2 Dividers constructed of same materials as tray, to separate cables; refer to drawings for quantity.

.3 Covers of solid or louvered type.

.4 Seismic restraints to local governing building code requirements to prevent horizontal movement.

.5 Grounding and bonding jumpers and hardware to maintain electrical continuity.

.6 Required supporting and installation accessories.

.3 Include for a trapeze configuration of threaded rod supports secured to ceiling slab and extending down to secure to steel C-channel support, creating a cradle for support of system. Cable tray to be connected continuously with no breaks.

.4 Prior to start of work, prepare and submit detailed installation drawings, including plans, elevations and sections of proposed tray and routing. Coordinate such drawings with coordination drawings of trades. Include for design calculations to determine load limitations.

.5 Clean final finish of burrs and other material or imperfections prior to installation of cabling, to satisfaction of Contract Administrator. Final finish to be smooth with no burrs that may damage cables.

.6 Provide tray complete with tray manufacturer’s grounding/bonding fittings and hardware.

.7 Provide conduit fittings where conduits enter tray and provide dropouts at ends where cables exit/enter. Supply cable installation rollers for pulling cables safely into tray. Provide rollers or other hardware to maintain cable-bending radii within cable manufacturer's recommended standards to suit type of cable. System accessories to be supplied by system manufacturer and be as recommended by system manufacturer for specific applications.

.8 Factory fabricate changes in direction, tees, 90° bends, universal dropouts, etc.

.9 Where cable tray penetrates fire rated construction, provide ULC listed and labelled, fire stopping and smoke seal materials or fittings to protect integrity of fire rated construction. Install work in compliance with ULC standards and where required by local governing codes, provide tray type suitable for plenum environments.

.10 Acceptable manufacturers are:

.1 Thomas & Betts;

.2 Legrand;

.3 Eaton B-Line;

.4 Canadian Electrical Raceways.

2.3 VENTILATED CABLE TRAY

.1 Thomas & Betts, CSA approved and labelled, outdoor weatherproof ventilated type cable tray as follows:

.1 in compliance with CSA C22.2 No. 126.1 and NEMA VE1;

.2 sized generally 300 mm W x 100 mm D (12" x 4") unless otherwise noted on drawings;

.3 tray constructed from steel conforming to requirements of ASTM A569 and be hot dip galvanized after manufacture and assembly, per CSA G164 or ASTM A123, providing minimum average thickness of 2.55 mils (0.06 mm) per side;

.4 rated for minimum CSA load D1 unless otherwise noted on drawings; cable tray to meet required NEMA/CSA load ratings with safety factor of 1.5 and also be able to support a 90 kg (200 lb) concentrated load at midspan over and above cable load;

.5 corrosion resistant mounting and installation supports, connectors and hardware;

.6 refer to drawings for approximate tray routings and lengths.

.2 Accessories:

.1 Factory made conduit connectors, couplers, fittings, tee sections, elbows, universal dropouts.

.2 Dividers constructed of same materials as tray, to separate cables; refer to drawings for quantity.

.3 Covers of solid or louvered type.

.4 Seismic restraints to local governing building code requirements to prevent horizontal movement.

.5 Grounding and bonding jumpers, fittings and hardware to maintain electrical continuity.

.6 Required supporting and installation accessories.

.3 Include for a trapeze configuration of threaded rod supports secured to ceiling slab and extending down to secure to steel C-channel support, creating a cradle for support of system. Cable tray to be connected continuously with no breaks.

.4 Prior to start of work, prepare and submit detailed installation drawings, including plans, elevations and sections of proposed tray and routing. Coordinate such drawings with coordination drawings of trades. Include for design calculations to determine load limitations.

.5 Clean final finish of burrs and other material or imperfections prior to installation of cabling, to satisfaction of Contract Administrator. Final finish to be smooth with no burrs that may damage cables.

.6 Provide conduit fittings where conduits enter tray and provide dropouts at ends where cables exit/enter. Supply cable installation rollers for pulling cables safely into tray. Provide rollers or other hardware to maintain cable-bending radii within cable manufacturer's recommended standards to suit type of cable. System accessories to be supplied by system manufacturer and be recommended by system manufacturer for specific applications.

.7 Factory fabricate changes in direction, tees, 90° bends, universal dropouts, etc.

.8 Where cable tray penetrates fire rated construction, provide ULC listed and labelled, fire stopping and smoke seal materials or fittings to protect integrity of fire rated construction. Install work in compliance with ULC standards and where required by local governing codes, provide tray type suitable for plenum environments.

.9 Acceptable manufacturers are:

.1 Thomas & Betts;

.2 Legrand;

.3 Eaton B-Line;

.4 Canadian Electrical Raceways.

3 Execution

3.1 INSTALLATION OF CABLE TRAY

.1 Provide sample of tray and detailed drawing layout of work prior to start of work, accurately dimensioned and showing required routing, penetrations, connections, bends, supports, etc.

.2 Obtain required training from manufacturer's representative on any special installation procedures. Install tray in accordance with manufacturer's instructions to suit specific installation requirements. Use manufacturer's recommended tools for cutting and installing tray.

.3 Drawings are diagrammatic and do not identify required changes in elevations and architectural features. Site measure exact routing and lengths. Provide detailed drawing layout of work prior to start of work, accurately dimensioned and showing required penetrations, connections, bends, etc.

.4 Install and hang cable tray at maximum 1.5 m (5') centres and in accordance with manufacturer's published literature employing horizontal bracket supported to ceiling slab by vertical threaded rod hangers. Do not secure assembly from ductwork, suspended ceiling structures, lighting, etc. Secure rod hangers directly to ceiling slab. Locate supports as not to interfere with removal or opening of covers. Typically locate spans at intervals ¼ span from supports, as recommended by tray manufacturer. Refer to drawing details and/or manufacturer's instructions. Include for provision of required seismic restraints as to comply with local governing building code requirements.

.5 Provide proper fittings in cable tray at points of conduit entry. Terminate conduits at or in tray with proper grommetted and bushed terminations.

.6 Equip tray with necessary wall flanges, dropouts, enclosures, reducers, fittings, and similar accessories required, maintaining effective free cross-sectional area of tray clear of obstructions that might damage conductor insulation during installation. Accessories are to be typically pre-manufactured by manufacturer to suit specific applications.

.7 Properly secure, adequately support and neatly harness conductors in tray. Seal cable tray penetrations of building fire barriers by means of ULC listed and labelled fire stopping and smoke sealing material.

.8 Provide continuous paths along entire lengths of cable tray to maintain proper ground continuity. Utilize system manufacturer's proper grounding and bonding fittings and hardware. Ground and bond system as per local governing electrical code requirements.

.9 File smooth cuts to tray and re-touch with galvanizing compound.

.10 Install expansion connectors where cable tray crosses building expansion joints.

.11 When installing cables into tray, do not exceed manufacturer's recommended load capacities for tray.

.12 After installation is complete, install warning signs on tray in visible locations.

.13 Inspect tray for rough finishing burrs, sharp edges, and mechanical deficiencies prior to installing of cabling. Eliminate these deficiencies to satisfaction of Contract Administrator, prior to installing cables.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings of products specified in this Section.

.2 Submit copies of documents requested herein, testing reports, certificate of approvals, and commissioning sheets.

2 Products

2.1 SEISMIC RESTRAINTS FOR CONTAINERIZED GENSETS

.1 Electrical equipment installed inside containerized genset enclosure to comply with local governing authority and code seismic requirements and additional requirements outlined herein.

.2 Supply labour, materials, and equipment required and necessary to seismically restrain electrical equipment and guarantee function of materials and equipment supplied.

.3 Make electrical connections to vibration-isolated equipment with flexible conduit or other flexible means acceptable to Contract Administrator so as not to restrict maximum anticipated movement of equipment under seismic excitation movement.

.4 Provide seismic restraining devices to restrain mechanical, electrical, and related equipment, and equipment bases including concrete pads, as per governing local authority requirements and requirements of current codes and by-laws.

.5 In event that inadequate isolation is provided by isolation product manufacturer's isolation package, genset vendor to be responsible for improving isolation to an acceptable standard at no additional cost to contract. Isolation product manufacturer's seismic restraint engineer to verify that seismic restraints and combination isolator/restraints intended for use on project are fit for intended purpose. Ensure that manufacturer's seismic restraints are in compliance with applicable local governing building code requirements for Place of Work.

.6 Include for manufacturer of vibration and seismic control products to engage a Professional Engineer registered or licensed in Place of Work and experienced in such Work, to develop/design seismic restraint system and perform seismic calculations in accordance with latest requirements enforced by local governing building code, requirements of local governing authority having jurisdiction, and additional requirements specified in this article. Design of seismic restraints to include provisions to withstand forces of site classification rating and importance category level as per governing building code requirements.

.7 Submit for Contract Administrator's review, seismic design drawings and product shop drawings with calculations approved and sealed by the Professional Engineer. Shop drawings to identify equipment type, manufacturer's name, model number and weight of equipment to be restrained.

.8 Shop drawings to additionally include placement drawings for electrical equipment and equipment assemblies including runs of cable trays and conduit/cable racks showing methods of attachment to particular structure for each piece of equipment and assembly and provide anchorage/attachment details. Submit samples of materials required to complete seismic restraint work for review if and when required. Include for Professional Engineer to inspect same on site (note that multiple inspections to be required as work progresses) and to provide typewritten Inspection Reports to Contract Administrator throughout construction and to provide "Letters of Assurance and Conformance" with specified Codes, Standards and Bylaws. Additionally, include copies of documents in Operating and Maintenance Manuals.

.9 Following electrical equipment require seismic protection:

.1 dry type distribution transformers;

.2 switchboards/switchgear;

.3 panelboards;

.4 engine/generator and associated components/accessories installed within enclosure, such as exhaust system and fuel system;

.5 generator control panel;

.6 fire alarm system, cabinets and devices;

.7 luminaires;

.8 conduit and duct banks.

.10 Neoprene Isolators:

.1 Neoprene isolators to be bridge bearing rated type manufactured from bridge bearing quality neoprene, CAN/CSA-S6 Section 11.5.8.

.2 Where a ribbed pad is used, height of ribs is not to exceed 0.7 times width of rib. A steel layer to be used to distribute load in a multi-layered unit.

.3 Select neoprene pads or elements at supplier’s optimum recommended loading and do not load beyond limit specified in neoprene manufacturer’s literature.

.4 Test neoprene isolators to ASTM specifications. Submit to Contract Administrator, following test data to verify performance of neoprene isolators:

.1 a data sheet listing ASTM test results;

.2 load deflection curves for isolator indicating deflection to full compression for both laterally restrained and unrestrained isolators.

.11 Open Steel Spring Isolators:

.1 Springs to be "Iso-Stiff" type with spring coefficient from 1.0 to 1.5.

.2 Spring mounts to be complete with levelling devices, minimum 6 mm (1/4") thick neoprene sound pads.

.12 Seismic restraints to restrain equipment in all directions and to be sized to meet appropriate Sp factor defined in Table 4.1.9.D of current National Building Code and Commentary J of Supplement to current Code. Calculations bearing seal of a qualified Professional Engineer to be submitted with shop drawings to justify stated seismic restraint requirements.

.13 Attachment points and fasteners to be capable of withstanding a load of 3 times sized capacity of restraint. Equipment suppliers to provide proof of conformance with this clause by means of shop drawings certified by a qualified Professional Engineer.

.14 Submit test data to Contract Administrator, showing load deflection curves up to 1.5 times rated capacity of restraint, and certifying that neither neoprene elements nor restraint body sustained any deformation after release of load.

.15 Adjust restraints to have clearances between 3 mm and 6 mm (1/8" – ¼") under normal operating conditions of equipment.

.16 Acceptable manufacturers of seismic restraints include:

.1 Vibro-Acoustics;

.2 Mason Industries;

.3 Kinetic Noise Control;

.4 Eaton B-Line.

2.2 VIBRATION CONTROL AND SEISMIC RESTRAINT

.1 Electrical equipment installation is to meet local governing authority having jurisdiction and code seismic requirements and additional requirements outlined herein.

.2 Provide labour, materials, and equipment required and necessary to seismically restrain electrical equipment and equipment bases including concrete pads, and guarantee function of materials and equipment supplied.

.3 Make electrical connections to vibration-isolated equipment with flexible conduit or other flexible means acceptable to Contract Administrator and local governing authority having jurisdiction so as not to restrict maximum anticipated movement of equipment under seismic excitation movement.

.4 In event that inadequate isolation is provided by isolation product manufacturer's isolation package, be responsible for improving isolation to an acceptable standard at no additional cost to contract. Isolation product manufacturer's seismic restraint engineer to verify that seismic restraints and combination isolator/restraints intended for use on project are fit for intended purpose. Be responsible for ensuring that manufacturer's seismic restraints are in compliance with applicable local building code requirements for Place of Work.

.5 Provide additional seismic requirements for suspended electrical raceways, luminaires, and other equipment as per governing local authority requirements and requirements of current codes and by-laws.

.6 Include for manufacturer of vibration and seismic control products to engage a Professional Engineer registered or licensed in Place of Work and experienced in such Work, to develop/design seismic restraint system and perform seismic calculations in accordance with latest requirements enforced by local governing building code, requirements of local governing authority having jurisdiction, and additional requirements specified in this article. Design of seismic restraints to include provisions to withstand forces of site classification rating and importance category level as per governing building code requirements.

.7 Submit for Contract Administrator's review, seismic design drawings and product shop drawings with calculations approved and sealed by the Professional Engineer. Shop drawings to identify equipment type, manufacturer's name, model number and weight of equipment to be restrained.

.8 Shop drawings to additionally include placement drawings for electrical equipment and equipment assemblies including runs of cable trays and conduit/cable racks showing methods of attachment to particular structure for each piece of equipment and assembly and provide anchorage/attachment details. Submit samples of materials required to complete seismic restraint work for review if and when required. Include for Professional Engineer to inspect same on site (note that multiple inspections to be required as work progresses) and to provide typewritten Inspection Reports to Contract Administrator throughout construction and to provide "Letters of Assurance and Conformance" with specified Codes, Standards and Bylaws. Additionally, include copies of documents in Operating and Maintenance Manuals.

.9 Use of manufacturer's isolation package is acceptable providing it meets requirements of this Specification.

.10 Provide vibration isolation for equipment or parts connected rigidly to isolated equipment.

.11 Provide vibration isolation for transformers by means of bridge bearing neoprene isolators or open steel spring isolators. Typical guidelines for static deflection of vibration isolators for electrical transformers are indicated in schedule below. Isolators requiring a static deflection greater than 13 mm (1/2") to be open spring isolators unless otherwise specified. Alternative proposals by vibration isolation manufacturers Engineer may be acceptable subject to supporting shop drawings with calculations supporting use of proposed products.

POWER RANGE (kVA)	ON GRADE (Isolated Slab)	LOCATION ON GRADE (Continuous Slab)	UPPER Floor (Suspended Slab)
Under 10	6 mm	6 mm	18 mm
10 - 100	6 mm	12 mm	25 mm
Over 100	6 mm	25 mm	38 mm

.12 Standard vibration isolation requirements of equipment such as gensets, power transformers and distribution equipment, to comply with following:

.1 select equipment isolation mounts on basis of achieving 98% vibration isolation efficiency at lowest operating speed;

.2 natural frequency of each vibration isolation system to be at least 1/10 of lowest excitation frequency of rotating machinery, whenever practicable, but in no case less than 1/7;

.3 where structural floor deflection exceeds 1/10 of determined static deflection of isolator, increase isolator static deflection to maintain this minimum ratio of floor to isolator deflection;

.4 where static deflections are shown on drawings, Specifications, or schedules, they are to be used as a guide only;

.5 actual isolators are to achieve required static deflection under load, with at least 50% reserve deflection;

.6 submit shop drawings identifying equipment, lowest operating speed, weight, brand, type and location of isolators prior to ordering or fabrication.

.13 Following typical electrical equipment require seismic protection (where applicable to Project):

.1 transformers;

.2 switchboards/switchgear;

.3 panelboards;

.4 engine/generator and generator control panel;

.5 automatic transfer switch;

.6 fire alarm system, cabinets and devices;

.7 luminaires;

.8 mobile generator connection box;

.9 conduit and duct banks;

.10 genset control system and cabinet;

.11 other electrical equipment, as required.

.14 Neoprene Isolators:

.1 Neoprene isolators to be bridge bearing rated type manufactured from bridge bearing quality neoprene, CAN/CSA-S6 Section 11.5.8.

.2 Where a ribbed pad is used, height of ribs is not to exceed 0.7 times width of rib.

.3 Steel layer to be used to distribute load in a multi-layered unit.

.4 Select neoprene pads or elements at supplier’s optimum recommended loading and do not load beyond limit specified in neoprene manufacturer’s literature.

.5 Test neoprene isolators to ASTM specifications. Submit to Contract Administrator, following test data to verify performance of neoprene isolators:

.1 Data sheet listing all of ASTM test results.

.2 Load deflection curves for isolator indicating deflection to full compression for both laterally restrained and unrestrained isolators.

.15 Open Steel Spring Isolators:

.1 Springs to be "Iso-Stiff" (spring coefficient 1.0 to 1.5) with a working deflection between 0.3 and 0.6 of solid deflection.

.2 Spring mounts to be complete with levelling devices, minimum 6 mm (1/4") thick neoprene sound pads, and zinc chromate plated hardware.

.3 Sound pads to be sized for a minimum deflection of 1.2 mm (0.0472") and meet requirements for neoprene isolators.

.16 Seismic restraints to restrain equipment in all directions and to be sized to meet appropriate Sp factor defined in Table 4.1.9.D of current National Building Code and Commentary J of Supplement to current Code. Calculations bearing seal of a qualified Professional Engineer to be submitted with shop drawings to justify stated seismic restraint requirements.

.17 Attachment points and fasteners to be capable of withstanding a load of 3 times sized capacity of restraint. Equipment suppliers to provide proof of conformance with this clause by means of shop drawings certified by a qualified Professional Engineer.

.18 Seismic Bracing:

.1 Typically used for suspended or hanging luminaires and cable tray systems.

.2 Braces constructed of assembly of multiple, high strength, zinc coated, steel wires, configured into cable with factory-attached stake eye end that attaches brace to building structure. Various specific cable strengths to suit seismic requirements. Colour coded.

.3 Pre-stretched bracing.

.4 Restraint clip connects cable brace to cable tray. Oval sleeve used to secure cable loop through restraint clip.

.5 Angle bracket end fittings for structure attachments and luminaire attachments.

.19 Submit test data to Contract Administrator, showing load deflection curves up to 1.5 times rated capacity of restraint, and certifying that neither neoprene elements nor restraint body sustained any deformation after release of load.

.20 Adjust restraints to have clearances between 3 mm (1/8") and 6 mm (1/4") under normal operating conditions of equipment.

.21 Acceptable manufacturers of seismic restraints include:

.1 Vibro-Acoustics;

.2 Mason Industries;

.3 Kinetic Noise Control;

.4 Eaton B-Line.

3 Execution

3.1 INSTALLATION

.1 Comply with seismic restraint Engineers and manufacturers design documents, and installation and adjustment recommendations. Refer to detailed shop drawings.

.2 Obtain required training from manufacturer's representative on any special installation procedures. Install components in accordance with manufacturer's instructions to suit specific installation requirements.

.3 Refer to Part 2 for additional specific installation requirements.

3.2 INSPECTION AND TESTING

.1 Inspect for removal of breakaway hardware to ensure proper torques of installed systems.

.2 Test, adjust, and certify installation.

.3 Comply with local governing authority requirements for testing, certification, documenting and labeling of seismic restraints.

.4 For non-visually verifiable product, manufacturers to verify proper torque for a minimum 10% of application, unless otherwise directed by local governing authorities. Document torques for applications per manufacturer's instructions.

.5 Submit copies of test report to Contract Administrator.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit as part of shop drawing submission, copies of:

.1 electrical distribution system protective device coordination study and short circuit calculations;

.2 system and equipment testing reports;

.3 arc flash analysis report;

.4 copies of certificate of approvals from local governing inspection authorities.

.2 Submit electrical distribution system coordination study and short circuit calculations reports prior to or with proposed shop drawings of major electrical distribution equipment. Allow in shop drawing process, sufficient time for Contract Administrator to review and make comments and for Contractor and equipment vendors to incorporate Contract Administrator comments, necessary revisions and results of reports into equipment shop drawings. Do not order equipment until shop drawings have been reviewed with Contract Administrator and Contract Administrator's comments have been addressed. Time for this shop drawing review process will be at Contract Administrator's discretion, but typically allow for 15 working days for initial review submission with additional 10 working days added to accommodate each resubmission.

.3 If formal completion of studies and reports may cause delay in equipment manufacture, direction from Contract Administrator may be obtained for preliminary submittal of sufficient data to ensure that selection of device ratings and characteristics will be satisfactory. Subsequently, provide formal studies and reports to verify preliminary findings.

.4 Submit after completion of factory testing, copies of completed product testing reports.

.5 Submit after installation and testing, copies of:

.1 completed testing reports with completed test results sheets;

.2 certificate of approvals from local governing authorities, manufacturers of systems and equipment and testing companies.

.6 Review form of submittals (submission procedures, number of hard copies and requirements for electronic copies) with Contract Administrator at project start-up. For pricing assume minimum 3 hard coloured copies bound and electronic pdf copy.

2 Products

2.1 GENERAL SCOPE OF WORK

.1 Include for but not be limited to following:

.1 preparing and submitting preliminary coordination study and short circuit calculations and recommendations on required relays, sensors and CT's for proper system selective coordination and protection;

.2 determining short-circuit current ratings to check that electrical distribution equipment can safely withstand level of fault current;

.3 preparing, determining and submitting arc flash study with calculations to ensure required electric shock and arc flash protection are provided;

.4 preparing and submitting ground potential rise (GPR) study;

.5 product manufacturers providing equipment inspection, testing, start-up, adjustments and verification;

.6 independent 3rd party testing of electrical distribution system equipment and associated products;

.7 independent 3rd party testing of systems and equipment as noted;

.8 electricians/trades people on site to handle equipment, make temporary connections, operate equipment and make repairs and adjustments and assist manufacturer's / testing organization's personnel during on-site inspection, testing, calibration, start-up, verification work and where supplementary commissioning;

.9 coordination of work with testing company and equipment/system manufacturer's authorized technician in performing adjustments and start-up procedures to equipment/systems;

.10 preparing testing reports and documentation for submission to Contract Administrator.

3 Execution

3.1 PRELIMINARY COORDINATION STUDY AND SHORT CIRCUIT CALCULATIONS

.1 Immediately after award of Contract liaise with local electrical supply authority for information on relays and other protective devices installed on their system and substations which affect co-ordination of site electrical distribution system.

.2 Immediately after award of Contract liaise with proposed manufacturer of electrical distribution equipment to obtain appropriate information and recommended devices to obtain co-ordination of electrical distribution system.

.3 Where project involves provision of major electrical distribution equipment (such as high voltage equipment, low voltage switchgear/switchboards, genset paralleling/synchronization switchboards), prepare preliminary coordination study and calculate available fault currents based on project design requirements and equipment. Combine into preliminary report and submit copies to Contract Administrator for review to allow for comments and findings to be incorporated into equipment shop drawings and to expediate shop drawing process.

.4 During Bid period, review with Mechanical Division Contractor, proposed major mechanical equipment and identify preliminary short circuit current ratings to allow for more accurate pricing for their proposed equipment.

.5 Prepare report to typical standards as specified in respective coordination study and short circuit calculation report articles in this Section.

3.2 DISTRIBUTION SYSTEM COORDINATION STUDY AND SHORT CIRCUIT CALCULATIONS

.1 Prepare final coordination study and short circuit calculations (available fault currents) of system. Perform work to standards of applicable local governing authorities, local electrical inspection authority and CSA Standards.

.2 Final coordination study and short circuit calculations reports to incorporate results and Contract Administrator reviewed comments, into electrical distribution equipment shop drawings, and updated to reflect final equipment being supplied. Check for selective coordination of devices and confirm withstand ratings of equipment meet results from reports. Prepare studies as required to provide full and proper coordination and suitable withstand rating of entire distribution equipment/systems.

.3 Protective system devices have been selected such that protection is adequate and good coordination is possible, however, since differences do exist between manufacturers, some changes in trip ratings or relay settings may be necessary and are to be carried out. Obtain local electrical utility information on their protective devices and include requirements as necessary.

.4 Provide and carry out following:

.1 prepare a set of coordination curves on K.E. No. 336E Time Current Characteristic graph paper;

.2 this is to be accompanied by supporting symmetrical as well as asymmetrical fault current calculation data with tabulations to verify protection of various elements of systems under maximum and minimum fault conditions at various points in systems.

.3 Plot time-current characteristic curves for following:

.1 main and feeder protective devices at voltage levels used in distribution system;

.2 protective devices associated with largest motor in each MCC, refrigeration machine compressors and largest device in each distribution panel;

.3 motor generator protective devices, damage curves and current decrement curves.

.5 Cooperate with and obtain from manufacturers, list of equipment requiring protective devices in distribution system and prepare coordination curves. Verify that proper withstand ratings of equipment are provided and proper control and protective devices are selected for coordination with protective devices. Include major mechanical equipment in studies and coordinate requirements with Mechanical Division Contractor. Identify required short circuit current ratings to Mechanical Division Contractor and respective Division manufacturers of major equipment.

.6 It is responsibility of equipment manufacturers to examine plans and specifications to ensure that relays and protective devices being installed in distribution system provide satisfactory coordination.

.7 Where automatic transfer switches are provided, submit coordination results and available fault current values at locations of transfer switches, to transfer switch manufacturer to ensure that transfer switches provided are of suitable withstand current ratings.

.8 Document testing, coordination study and arc flash analysis in a report stamped and signed by a Professional Engineer licensed in the Place of Work and authorized by testing company. Report to include test results with properly plotted curves, identified trouble areas of coordination, extensive comments regarding test results and recommendations on best course of remedial action. Submit copies of report to Contract Administrator.

.9 Acceptable companies to provide this work are to be successful manufacturer of electrical distribution system equipment and include:

.1 Eaton Electric Services Division;

.2 Schneider Electric Services Division;

.3 Siemens Electric Services Division.

3.3 GENERAL ELECTRICAL WORK TESTING

.1 In addition to tests required by local governing authorities having jurisdiction, local codes and regulations, perform following:

.1 after luminaires, switches, receptacles, motors, signals, etc., are installed, whether same are installed as part of this Division or by other Divisions (telephone systems excepted), test work to ensure that there are no leaks, grounds or crosses;

.2 establish and ensure proper motor rotation - measure full load running currents and check overload elements - report to Contract Administrator any discrepancies which are found; existing motors which have been worked on (disconnected and reconnected) must be checked with rotation meter to ensure proper rotation; be responsible for any damage caused by reverse rotation;

.3 demonstrate to Contract Administrator that branch circuit voltage drop is within specified units;

.4 ensure that devices are commissioned and operable.

.2 Rectify deficiencies to satisfaction of The City.

.3 Document results into distribution system testing report. Report must state that testing was successful and Work complies with project documents, applicable CSA standards, and other applicable governing codes and requirements.

3.4 SYSTEMS INSPECTION, TESTING, START-UP AND VERIFICATION

.1 When each system and each major piece of equipment installation is complete and ready for acceptance, include for system and equipment manufacturer or manufacturer's authorized representative to visit site to provide system inspection, testing, start-up, and verification. Perform following:

.1 check component connections and overall installation;

.2 adjust sound systems for high quality, distortion free performance, free from noise, cross-talk, hum or other interference;

.3 test and adjust system and ascertain that components are as specified and ensure that products operate as designed;

.4 provide start-up procedures for systems and equipment;

.5 verify and certify system component operations;

.6 prepare, document and evaluate test results;

.7 authenticate test results with signature of authorized testing Engineer/Technician;

.8 check and verify nameplates;

.9 provide maintenance and operating instructions to The City's personnel.

.2 Perform work properly documented, and in accordance with manufacturer's instructions and recommendations.

.3 Perform work under presence of The City/Contract Administrator/Commissioning Agent at times approved by The City and reviewed with Contract Administrator.

.4 Where project includes LEEDs requirements, prepare, document, evaluate test results and provide additional documentation during inspection, start-up, testing and verification work that includes but is not limited to:

.1 submission of necessary LEED forms indicating percentage of recycled content in manufactured materials and devices to LEED Contract Administrator;

.2 testing and adjusting systems and ascertaining that components are as specified and adhere to LEED requirements;

.3 verification of systems and ensuring that operation and design of systems adhere to LEED requirements.

.5 Provide these requirements after each phase (as applicable) to allow The City option to use area of phase of work. These requirements are also to be provided prior to applying for Certificate of Substantial Performance of the Work of project.

.6 Include for manufacturers authorized technicians of equipment/systems integrated to equipment/systems being tested to be onsite during full integration testing. Coordinate with each manufacturer.

.7 Rectify deficiencies to satisfaction of The City.

.8 When system inspection, testing, start-up and verification specified above is complete, obtain from supplier/manufacturer (or where specified, independent inspection company) a test report with test sheets, and covering verification letter signed by authorized testing technician, stating that system or equipment has been inspected and tested, performs as specified and is ready for acceptance. Include date and time of testing, testing technician's name and specification section number test fulfilled.

.9 Bind documents under cover and submit copies to Contract Administrator.

3.5 GROUND POTENTIAL RISE STUDY

.1 Prepare a ground potential rise (GPR) study to ensure that ground system complies with requirements of local governing electrical code, for protection of personnel and equipment. GPR study to include but not be limited to:

.1 site review of ground system;

.2 soil resistivity test;

.3 computer modelled ground system design;

.4 safety calculations and recommendations;

.5 GPR calculations and written report.

.2 Perform ground resistivity testing of soil to determine measurement expressed in ohm-meters as defined by IEEE 80-2000 - IEEE Guide for Safety In A.C. Substation Grounding. Use 4-point method with Model 4610 or Model 4500 Ground Tester or approved equal, and insertion of four equally spaced and in-line electrodes into test area.

.3 Include date and time of testing, testing technician's name and signature. Bind documents under cover with distribution system testing report and copies to Contract Administrator.

.4 Acceptable companies to prepare study to be as listed for distribution system testing and coordination study work.

3.6 ELECTRICAL DISTRIBUTION SYSTEM TESTING AND VERIFICATION

.1 Provide services consisting of on-site engineering inspection, testing and verification of electrical distribution equipment and other systems and equipment. Perform work to standards of applicable local governing authorities, local electrical inspection authority and CSA Standards.

.2 Services to be performed by an approved independent testing company and be initially conducted prior to system/equipment being energized and further testing when energized, and include following items, where applicable:

.1 testing, cleaning when necessary, and calibrating relays and circuit breaker trip devices (calibration of protective devices to conform to requirements of approved coordination curves);

.2 function test of associated control devices;

.3 replacement of fuses destroyed during testing;

.4 acceptance test in presence of Contract Administrator;

.5 presence, for length of time required, of qualified and competent equipment manufacturer's service representative during start-up;

.6 carry out insulation resistance testing of outgoing feeders with respect to ground;

.7 inspection and testing of cables, bus duct, power panels, lighting panels, transformers, power receptacles and switches;

.8 inspection and testing of electrical system auxiliary systems and devices such as metering, power factor capacitors, UPS, isolated power centres, transfer switches, inverters, central battery systems, generators sets and load banks;

.9 inspection and testing of electrical devices and communication system components installed in service consoles, headwalls, furniture systems, etc., whether or not devices are supplied by Electrical Divisions;

.10 inspection and testing of motor control centres, starters and variable frequency drives;

.11 inspection and testing of lighting control systems including central control systems, low voltage relays, sensors and dimming controls; ensure that devices perform in conformance with ASHRAE 90.1 requirements;

.12 verification and certification work of equipment and systems;

.13 witness testing of EMI testing and verification (signing of report) of test results.

.3 In addition to above testing and tests required by local governing authorities having jurisdiction, local codes and regulations, perform following:

.1 after luminaires, switches, receptacles, motors, signals, etc., are installed, whether same are installed as part of this Division or by other Divisions (telephone systems excepted), test work to ensure that there are no leaks, grounds or crosses;

.2 establish and ensure proper motor rotation - measure full load running currents and check overload elements - report to Contract Administrator any discrepancies which are found; existing motors which have been worked on (disconnected and reconnected) must be checked with rotation meter to ensure proper rotation; be responsible for any damage caused by reverse rotation;

.3 demonstrate to Contract Administrator that branch circuit voltage drop is within specified units;

.4 ensure that devices are commissioned and operable.

.4 Perform services procedures properly documented, and in accordance with manufacturer's instructions and recommendations.

.5 When performing hi-potential testing, disconnect surge protection devices as recommended by SPD manufacturers.

.6 Where relays, breakers, etc., do not perform to Contract Administrator reviewed coordination curves as prepared for in coordination study, revise as part of work.

.7 Test high voltage cable installation before placing in regular service. Work includes phase verification, grounding verification, hi-pot test of insulation strength to IPCEA Specifications (Leakage Curves to be obtained), and time domain reflectometer tests to give records of cable impedance profiles to draw attention to cable damage. Reference cable manufacturers testing procedures and do not exceed maximum test voltage levels and durations.

.8 Testing organization to report high voltage cable defects directly to Contract Administrator as soon as such defects are discovered. Re-test affected cables after proper repair. Also, re-test cables in cases where cable damage after installation is suspected. On completion of satisfactory testing of installation, submit a report by testing organization stating that cables concerned have satisfactorily passed required tests and are suitable for service. Submit copies of report to Contract Administrator. Submit recorded test data (properly bound) with report, in each case.

.9 Test main power transformers before placing in regular service. Work to include voltage ratio test, phase angle test, insulation resistance, oil sampling (liquid type transformer), start-up and other manufacturer's recommended tests.

.10 Provide testing and coordination of emergency power distribution system to ensure that system performs in accordance to latest requirements of CSA Standard C282. Ensure that engine-generator set manufacturer and testing and coordination companies co-operate to ensure compliance with CSA requirements. Provide necessary adjustments and coordination to ensure that emergency power distribution system transfers essential loads to emergency power within required response time of loss of normal power.

.11 Provide visual and mechanical inspection of ground system and verify that it is in compliance with issued documents and local governing electrical code requirements.

.12 Perform fall-of-potential test or alternative in accordance with IEEE Standard 81 on main grounding electrode or system to determine current status, possible grounding contamination and proper ground resistance value. Perform point-to-point tests to determine resistance between main grounding system and major electrical equipment frames system neutral, and/or derived neutral points. Resistance between main grounding electrode and ground is not to be typically greater than 5 ohms for commercial or industrial systems and 1 ohm or less for generating or transmission station grounds unless otherwise specified. (Reference: ANSI/IEEE Standard 142). Investigate point-to-point resistance values which exceed 0.5 ohm.

.13 Perform testing of lighting control systems and devices to ensure conformance with ASHRAE 90.1 requirements.

.14 Coordinate testing of equipment and systems with respective product vendors as required to ensure alliance with product vendor standards.

.15 Document testing, coordination study and arc flash analysis in a report stamped and signed by a Professional Engineer licensed in the Place of Work and authorized by testing company. Submit copies of report to Contract Administrator. Report to include test results with properly plotted curves, identified trouble areas of coordination, extensive comments regarding test results and recommendations on best course of remedial action. Report must state that testing was successful and Work complies with project documents, applicable CSA standards, and other applicable governing codes and requirements.

.16 Any work that failed testing that was responsibility of Contractor to be rectified by Contractor and be re-tested and verified, until successful testing, and be at no additional cost to The City. Rectify deficiencies to satisfaction of The City and Contract Administrator.

.17 Acceptable companies to provide equipment and system testing and verification work are to be independent of successful manufacturers providing distribution system equipment and include (unless otherwise approved by The City, do not use company supplying electrical distribution equipment on project):

.1 G.T. Woods;

.2 AC Tesla;

.3 EnKompass Power and Energy;

.4 Eaton Electric Services Division;

.5 Schneider Electric Services Division;

.6 Siemens Electric Services Division;

.7 Eastenghouse.

3.7 UPS TESTING

.1 In addition to standard specified testing requirements, UPS system manufacturer to include during onsite testing, full documented testing and results including but not limited to following:

.1 recording functional alarms and voltage levels at which alarm occurs, on UPS system;

.2 recording critical load alarms and voltage levels at which alarm occurs, on UPS system;

.3 recording minimum and maximum adjustment of voltage potentiometer on system;

.4 recording levels and checking functionality of battery equalize feature;

.5 testing operation of remote EPO functions;

.6 recording load testing data with 0%, 50% and 100% load for function of input VAC/IAC/THD%, VDC/IDC (charging), output VAC/Φ-ΦV average/IAC, output kW/kVA/Hz and output voltage THD%;

.7 determine voltage regulation from 0% to 100% full load;

.8 determine voltage unbalance of system at 0%, 50% and 100% kW load;

.9 record transient response of system under load steps of 0-50%, 50-0%, 50-100%, 100-50%, 100% (UPS to bypass), 100% (bypass to UPS) and 100% simulated fuse failure; load percentages; Refer to kW rating of unit; record 3-phases of output voltage, 1-phase of output current and one phase of input voltage; attach printouts with report;

.10 perform battery discharge test; record battery details, specifications and operating data; load system to 100% kW load and record DCV and DCA at one minute intervals from 0-20 minutes, record 3-phases of output voltage, one phase of output current and one phase of input voltage; attach printouts with report;

.11 record voltage levels and times at which Battery Discharge/Low Battery Warning/Low Battery Shutdown occur during discharge test;

.12 during battery charge (no load), record battery current limit (ADC, 10%) and reduced battery current limit (ADC, 1%);

.13 after battery recharge current has reached OA following battery capacity test, perform 125% overload test and verify/record overload alarm, input current limit (115%), reduced input current limit (100%), overload transfer alarm, auto-retransfer primed alarm and auto-retransfer successful (no alarm);

.14 perform full load system burn-in; record at 30 minute intervals with 100% kW on system for 4 hours continuous, O/P volts ΦA-B/ΦB-C/ΦC-A, O/P amps ΦA/ΦB/ΦC; if failure occurs, repair and start test over from beginning until 4 hours continuous operation are achieved;

.15 test system options and features to ensure proper operation.

.2 Document testing in report signed by UPS manufacturer's technician. Submit copies of report to Contract Administrator.

3.8 SHOCK AND ARC FLASH ANALYSIS

.1 General:

.1 Provide analysis for electric shock and arc flash protection as specified herein, and as required by local governing codes and local governing authorities.

.2 Prepare study to determine severity of potential exposure and selecting personal protective equipment (PPE) under general guidelines of governing edition of CSA Z462.

.3 Determine arc flash hazard distance and incident energy that workers may be exposed to from electrical equipment under general guidelines of IEEE 1584.

.4 Design safety signs and labels for applications to equipment under general guidelines of CSA Z462 and ANSI Z535.4.

.5 Incorporate documentation with short circuit calculations and coordination study report submitted to Contract Administrator.

.2 Arc Flash Hazard Analysis Study:

.1 Perform Arc Flash Hazard analysis by calculating arc flash incident energy and arc flash boundaries as outlined in CSA Z462. Analysis to include locations where work could be performed on energized parts of equipment such as switchboards, switchgear, motor-control centres, panelboards, busway and splitters.

.2 Retrieve short circuit calculations and clearing times of phase overcurrent devices from short circuit and coordination study specified previously.

.3 Arc-Flash Hazard Analysis to include customer owned service entrance equipment down through equipment rated 208 volts with significant locations in 240 V and 208 V systems fed from transformers equal to or greater than 35 kVA.

.4 Specify safe working distances based upon calculated arc flash boundary considering incident energy of 1.2 cal/cm^2.

.5 Include Arc Flash Hazard analysis calculations for maximum and minimum contributions of fault current magnitude. Minimum calculation to assume that utility contribution is at a minimum and a minimum motor load. Conversely, maximum calculation to assume a maximum contribution from utility and motors to be operating under full-load conditions. Other switching scenarios are to be included as necessitated by power system design and layout.

.6 Arc Flash computation to include both line and load side of main breaker, where necessary.

.7 Arc Flash calculations to be based on overcurrent protective device clearing time per coordination study.

.3 Arc Flash Warning Labels:

.1 Provide minimum 90 mm x 127 mm (3.5" x 5") thermal transfer type label of high adhesion polyester for each work location analysed.

.2 Typically, use red header label with “DANGER, ARC FLASH HAZARD” wording. Typically, use orange header label with wording, "WARNING, ARC FLASH HAZARD", and include following information:

.1 Location/equipment designation;

.2 nominal voltage;

.3 arc flash protection boundary;

.4 incident energy;

.5 working distance;

.6 engineering report number, revision number and issue date.

.3 Machine print labels with no field markings. Submit as shop drawing submissions, sample labels and proposed nomenclature for The City approval and Contract Administrator review.

.4 Provide Arc Flash labels typically for following equipment (and base labels on recommended overcurrent device settings:

.1 panelboards;

.2 motor control centres/VFDs;

.3 distribution transformers;

.4 switchboards;

.5 transfer switches;

.6 genset control equipment;

.7 switchgear;

.8 high voltage equipment;

.9 other equipment as outlined on drawings, and required by local governing authorities.

.5 Document in report, method of calculating and data to support information for labels.

.4 Acceptable companies to provide this work are to be successful manufacturer of electrical distribution system equipment and include:

.1 Eaton Electric Services Division;

.2 Schneider Electric Services Division;

.3 Siemens Electric Services Division;

3.9 EMI TESTING

.1 Electromagnetic interference testing to include provisions as outlined herein. Prior to start of Work, prepare method of procedure using requirements herein as guideline. Submit proposed method of procedure to Contract Administrator for review.

.2 Standards:

.1 IEEE 1308-1994 (R2010), IEEE Recommended Practice for Instrumentation: Specifications for Magnetic Flux Density and Electric Field Strength Meters - 10 Hz to 3 kHz.

.2 IEEE 644-994 (R2008), IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines.

.3 Instrumentation: Single axis or tri-axial probes with appropriate electrical meter, frequency response 40-400Hz., and overall accuracy 1% or better.

.4 Measurement of Magnetic Fields:

.1 Measure magnetic field throughout entire area where magnetic field might be present in excess of acceptable limits. Take special care in areas of patient care, intensive care, operating rooms, diagnostic rooms, and above and in close proximity of main electrical rooms and main power feeders such as bus ducts risers, cable runs etc.

.2 Measure magnetic field in regular space intervals. Standard interval to be a mesh 1800 mm x 1800 mm (6' x 6'). Measurement height above floor to correspond with desk top level (900 mm (3') above floor) and at either, at floor (in case of magnetic field being generated below), or 1800 mm (6') from floor (in case magnetic field is generated above), and alongside wall in adjacent rooms (500 mm (20") from wall).

.3 Measure each point flux density in three orthogonal directions (X, Y, Z) and recorded separately. Recorded value is average of maximum and minimum values to eliminate time variance of magnetic field.

.4 Add recorded values vectorially to obtain representative value of magnetic flux density for individual measuring point.

.5 Carry out magnetic field survey at time of maximum electrical power load. If this is impracticable, a simulated load by means of short circuit test at design maximum current is acceptable.

.6 Acceptance criterion is 5 mG (RMS) at measuring points.

.5 Substation Radiation Measurements:

.1 Measure magnetic field must be measured at points1800 mm (6') below and/or above, and/or 1800 mm (6') from each side, at representative locations in accordance with switchgear configuration. Points to be covered are incoming cells and larger feeder cells.

.2 Load switchgear with a simulated load equal to design maximum closely resembling actual load. Load can be simulated by load banks, but it is recommended to carry out testing using a short circuit test.

.3 In case of double-sided substations, it is recommended to test transformers and switchgear together. Test substation both with tiebreaker open and closed.

.4 Measure at each point flux intensity in three (3) orthogonal directions (X, Y, Z) and recorded separately. Recorded value is average of minimum and maximum values in each direction to eliminate influence of additive and subtractive external fields.

.5 Add 3 orthogonal readings vectorially to obtain representative value for individual measurement point.

.6 Measure and record at each measuring point, flux density with switchgear de-energized to establish background magnetic field.

.7 Acceptance criterion is 5 mG (RMS) at measuring points.

.6 Testing, verification and certification to be performed by specialist Subcontractor. Contract Administrator and independent testing company performing distribution system testing and coordination study work to witness testing work. Ensure that independent testing company verifies and co-signs test results. Perform testing and verification work at times acceptable to The City and reviewed with Contract Administrator. Include results in report submitted to Contract Administrator.

.7 Acceptable companies to provide this work includes:

.1 C-Intech;

.2 Power Line Systems Engineering.

3.10 INFRARED SCANNING

.1 Provide infrared scanning of Work and connections to electrical distribution equipment as noted.

.2 Infrared scanning process to include but not be limited to following:

.1 use of latest technology infrared fast scanning thermal imaging camera with colour digital conversion thermographic imaging capabilities; camera to determine temperature differences using generated isotherms;

.2 scanning distribution system with ability to detect 1°C between subject area and reference at 30°C;

.3 equipment to detect emitted radiation and convert detected radiation to visual image;

.4 infrared surveys to be performed during periods when equipment is under intended full operating load;

.5 perform scanning of essential power equipment when gensets are in operation and essential power is on line.

.3 Some guidelines for interpretation of temperature gradients are:

.1 temperature gradients of 3°C to 7°C indicate possible deficiency and warrant investigation;

.2 temperature gradients of 7°C to 15°C indicate deficiency; required repair as time permits as directed by Contract Administrator;

.3 temperature gradients of 16°C and above indicate major deficiency; requires repair immediately.

.4 Document testing in a report stamped and signed by a Professional Engineer licensed in the Place of Work and authorized by testing company. Submit copies of report to Contract Administrator. Report to include but not be limited to include:

.1 indication of problem area (location of "hot spot");

.2 indication of temperature rise between "hot spot" and normal or reference area;

.3 indication of cause of heat rise;

.4 indication of phase unbalance, if present;

.5 indication of areas scanned;

.6 colour photographs and thermograms of deficient area as seen on imaging system;

.7 summary of work;

.8 list of test equipment;

.9 faults, corrections required, recommendations;

.10 retesting of corrected faults.

.5 Acceptable infrared scanning companies:

.1 GT Wood;

.2 EnKompass Power and Energy;

.3 AC Tesla;

.4 Eaton Electric Services Division;

.5 Schneider Electric Services Division;

.6 Siemens Electric Services Division;

.7 Eastenghouse.

END OF SECTION

1 General

1.1 SUMMARY

.1 Related Documents:

.1 Drawings and general provisions of the Contract/ Subcontract apply to this Section, including General and Supplementary conditions and all Division Specifications Sections, apply to this Section.

.2 This section covers the Contractor's responsibility for commissioning; each subcontractor or installer responsible for installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item

.3 Review these documents for coordination with additional requirements and information that apply to work under this Section.

.2 Section Includes:

.1 This section specifies the unique responsibilities that are a part of, or are related to the commissioning process for the electrical systems. Electrical systems include those listed in Division 01 Section "General Commissioning Requirements" as being commissioned. All statements are the responsibility of the Subcontractor, unless specifically stated otherwise.

.2 Electrical testing specified for systems not listed as formally commissioned are not under the commissioning umbrella and are not governed by this section.

.3 Electrical Systems Commissioning consists of static checks of component and system installations and review of all electrical testing executed by Authorities Having Jurisdictions / Independent Electrical Testing Authority/ CTC (Certified Testing Company) .

.4 Electrical Systems Commissioning consist of testing of monitoring, alarms and communication from the Electrical Systems to other building systems

.5 Electrical Systems Commissioning consists of verification of the operation normal and emergency power including but not limited to the resumption of power after power transfers and /or power loss.

.6 The Commissioning Authority or the City will review and approve, prior to use, all test procedures and forms used and will witness a varying fraction of the initial checks and testing performed by the Subcontractor. The Commissioning Authority will review the completed check and test documentation of the Subcontractor of all checks and tests.

.7 Electrical testing requirements are found in various sections in Division 01 and in Division 26 (Division 01 Section "General Commissioning Requirements" and this section). It is not the intent of the commissioning process or these specifications to duplicate efforts or to require the Subcontractor to perform any check or test twice. Checks and testing by the Subcontractor are expected to occur once in the normal sequence of installation and checkout, if appropriate coordination has occurred allowing the City and the Commissioning Authority to witness installations and initial testing. Identical electrical checks and testing requirements in both Division 01 and Division 26 are referring to the same event.

.8 The test requirements listed in this section do not release the Subcontractor from the obligation to perform all other appropriate, industry standard, manufacturer-recommended or code-required checks and tests.

.9 Testing Participants. The work of this section shall be performed by parties identified in the Check and Testing Responsibility Table--a supplement to Division 01 Section "General Commissioning Requirements". Static checks and testing shall be fully documented according to provisions in Division 01 Section "General Commissioning Requirements".

.3 Related Sections:

.1 Division 01 General Requirements

.2 Division 21 Fire Suppression

.3 Division 22 Plumbing

.4 Division 23 HVAC

.5 Division 25 Integrated Automation

.6 Division 26 Electrical

.7 Division 28 Electronic Safety and Security

1.2 REFERENCES

.1 General:

.1 The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

.2 Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

.3 Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

.4 Refer to Division 23 Section "Common Results for HVAC" for codes and standards, and other general requirements.

.2 Standards

.1 ASHRAE Guideline 0 – The Commissioning Process, 2013

.2 ASHRAE Guideline 1.1 – The HVAC&R Technical Requirements for the Commissioning Process, 2012

.3 ASHRAE Standard 202 - Commissioning Process for Building and Systems, 2013

.4 CSA Z320-11 – Building Commissioning

.5 CaGBC LEED V4 BD+C

.6 ANSI / NETA Standards

.7 Canadian Electrical Safety codes

1.3 DESCRIPTION

.1 The purpose of commissioning is to ensure the City that work has been completed as specified and that systems are functioning in the manner as described in Division 26 Section "Common Results for Electrical" and specified system operating criteria. It will assist operating staff training and familiarization with new systems. It will serve as a quality assurance program to reduce post-occupancy critical systems operational difficulty or failure. It will, also, be used to develop test protocol and record the associated test data in

an effort to advance the building systems from a state of substantial completion to a full dynamic operation.

.2 Commission will commence after startup of equipment and systems have been confirmed as under power, meggered, with confirmed verification of safeties and protective devices.

.3 Commissioning work shall include, but not be limited to:

.1 Attendance at all Commissioning Meetings.

.2 Preparation of Commissioning Plan.

.3 Preparation of Commissioning Schedule.

.4 Development and completion of Commissioning Report forms and check sheets for each system and piece of equipment.

.5 Demonstration to the City and Contract Administrator(s) that the equipment/system have been installed per contract documents.

.6 Preparation of O&M Manual.

.7 Preparation of Record Drawings.

.8 Start-up and verification of systems and equipment.

.9 Performance testing of equipment.

.10 Review and verification of Testing, Adjusting and Balancing work and report.

.11 Correction of all deficiencies and performance deviations.

.12 Demonstration and training to the City and Contract Administrator of all systems and equipment provided in this Division.

.13 Preparation and assembly of Commissioning Documentation.

.14 Coordination of Division 23 - HVAC commissioning activities with all other trades.

.4 Coordinate with and assist Division 21 - Fire Suppression, Division 22 - Plumbing, Division 25 - Integrated Automation, Division 26 – Electrical, and Division 28 – Electronic Safety & Security for commissioning of their respective works.

.5 The milestones associated with commissioning are outlined below:

.1 Installation Verification

.2 System Start-Up.

.3 Functional Performance Testing.

.4 Issues Review and Retesting

.5 Operations and Maintenance Manual Review

.6 Building Operations Demonstration and Training

.7 Seasonal Testing and Warranty Review (as required)

.6 Operational staff training is essential to the commission process and will run concurrently with the commissioning milestones listed above.

.7 The Commissioning Team will include representatives of the City, Construction and Installing Subcontractors, Test and Balance Subcontractor, FMCS Subcontractor and Construction Subcontractor's Commissioning Agent. Equipment manufacturer's representatives will be present for start-up as specified in the equipment specification sections and for equipment training.

1.4 SYSTEMS TO BE COMMISSIONED

.1 Commissioning will be performed on the following systems:

- .1 Switchboards
- .2 Metering
- .3 Lighting Control
- .4 Grounding
- .5 Surge Suppression
- .6 Heat Tracing

1.5 SUBMITTALS

.1 See Section 01 33 00 – Submittal Procedures.

.2 Construction Schedule with Commissioning Milestones

.3 Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

.4 Calibration certifications of all testing equipment to be used during functional testing period

.5 Equipment Factory Acceptance Tests

.6 Start up and testing procedures

.7 Start-Up Reports including but not limited to Manufacturer Start-Up Reports, prefunctional checklists, pressure and leakage tests, BAS point to point verification reports and graphics and TAB reports for CxA Approval and Review.

- .1 Proof of Coordination of Protective Devices including:
  - .1 Settings of overcurrent trips, relays, circuit breakers, fuses and ground fault
  - .2 Short Circuit Analysis
  - .3 Verification of incoming services
  - .4 Harmonic Studies
  - .5 Megger Tests and associated insulation resistance testing

.8 Method of Procedures as required for any required shut-downs for testing

.9 Training Requirements, agenda, and schedule

- .1 Draft Training Plan: In addition to requirements specified in Section 01 79 00, include:
  - .1 Follow the recommendations of ASHRAE Guideline 1.
  - .2 Control system manufacturer's recommended training.
  - .3 Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.

.10 Training Manuals: See Section 01 79 00 for additional requirements.

.11 Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

.12 Operations and Maintenance Manuals

.1 Electrical Systems O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the electrical system:

.2 Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in electrical training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the panel schedules, single line diagrams, and alarms and monitoring points at Control Panels and HMIs

.3 Full as-built set of drawings and single line diagrams.

.4 Full as-built sequence of operations for each piece of equipment.

.5 Full print out of all test and verification reports, and acceptance of the system performed by the Contractor, and / or Certified Testing Company.

.6 Electronic copy on disk of the entire program for this facility.

.7 Maintenance instructions, including calibration requirements, emergency and protective settings.

.8 Warranty requirements.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 The CTC (Certified Testing Company) performing the work of this section shall be qualified to test electrical equipment and is a NETA (National Electrical Testing Association)-certified testing agency. The CTC shall not be associated with the manufacturer of equipment or systems under test.

.2 Test Equipment:

.1 The Subcontractor shall provide all test equipment necessary to fulfill the checks and testing requirements. Test equipment shall have been calibrated within one (1) year of its use on the project.

.2 Refer to Division 01 Section "General Commissioning Requirements" for additional requirements.

2 Products

2.1 COMMISSIONING PLAN

.1 The commissioning plan shall outline the organization, scheduling, team members, and documentation pertaining to the overall commissioning process.

2.2 NARRATIVE DESCRIPTIONS

.1 A narrative description of the design intents of the systems and their intended modes of sequences of operation.

2.3 PREFUNCTIONAL CHECKLISTS

.1 Draft Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:

.1 System name.

.2 List of devices.

.3 Step-by-step procedures for testing each controller after installation, including:

.4 Process of verifying proper hardware and wiring installation.

.5 Process of downloading programs to local controllers and verifying that they are addressed correctly.

.6 Process of performing operational checks of each controlled component.

.7 Plan and process for calibrating valve and damper actuators and all sensors.

.8 Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.

.9 Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.

.10 Description of the instrumentation required for testing.

.11 Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.

2.4 FUNCTIONAL TEST PLANS (FTPS)

.1 The FTP procedures at the minimum shall consist of the following sections:

.1 Narrative Description:

.1 This section provides a narrative description of the design intents of the systems and their intended modes of sequences of operation.

.2 Testing Prerequisites:

.1 This section contains verification that primary mechanical, electrical, and controls systems that support or interact with the system that the FTP is prepared against are completed, tested and operational.

.3 Installation Verification:

.1 This section contains verification that the system installation is completed and is ready for commissioning.

.4 Commencement of Functional Performance Testing:

.1 This section records the date and time of the start of system commissioning.

.5 System Condition Prior to Staring Performance Testing:

.1 This section records the current set points and parameters of the system at the start of commissioning.

.6 Functional Performance Test:

.1 This section shall provide the following:

.1 Sequential steps required to set parameters and conditions required to test component and functions throughout intended ranges of operation.

.2 Full range of checks and tests carried out to determine if electric and pneumatic connections, components, subsystems, systems

and interfaces between systems function in accordance with the contract documents and design intents.

.3 All modes and sequences of control operations, interlocks and conditional control responses and specified responses to abnormal emergency conditions.

.7 End of Functional Performance Test:

.1 This section records the date and time of the end of system commissioning.

.8 Issue Log:

.1 This section records notes or remarks during system commissioning.

.2 List systems modifications, not required by the Contract Documents, but provided by the Subcontractor. List other questions regarding such system modifications.

.3 List problems discovered during Commissioning that were corrected.

.4 List problems discovered during Commissioning that were not corrected.

.5 List recommended party that should take action on these problems.

3 Execution

3.1 SUBMITTALS

.1 Submit under provisions of Divisions 01 Section "General Requirements" and "Special Procedures."

.2 Sixty (60) days before any testing is conducted, submit an overall testing plan and schedule for electrical systems that lists the equipment, modes to be tested, dates of testing and parties conducting the tests. Put these tests into the master construction schedule. Keep this plan and schedule updated.

.3 Additional submittal requirements relative to commissioning are found in this Section and in Division 01 Section "General Commissioning Requirements" and Division 01 Section "General Requirements."

3.2 COMMON RESPONSIBILITIES

.1 The following are responsibilities applicable to all electrical systems being commissioned.

.2 The general commissioning requirements and coordination are detailed in Division 01 Section "General Commissioning Requirements" and apply to electrical systems. The Subcontractor shall be familiar with all parts of Division 01 Section "General Commissioning Requirements" and the commissioning plan issued by the Commissioning Authority and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

.3 The work of this Section shall be performed by a CTC (Certified Testing Company, Electrical), by the EC (Electrical Subcontractor), or the MSR (Manufacturer's Service Representative). The Commissioning Authority has some testing responsibilities for some equipment. The specified checks and static tests are conducted by any of the above listed parties, but the tests requiring measurements or special tools or skills are generally conducted only by the CTC. The Check and Testing Responsibility Table, included as a supplement to Division 01 Section "General Commissioning Requirements" provides specific allocation of checklist oversight and testing responsibilities. The CTC, EC, and MSR

shall document all checks and testing on check and test procedure forms submitted to and approved by the Commissioning Authority prior to testing.

.4 The Subcontractor shall notify the City ahead of time when commissioning activities not yet performed or not yet scheduled will delay construction. The Subcontractor shall be proactive in seeing that commissioning processes are executed and that the CA has the scheduling information needed to efficiently execute the commissioning process.

.5 The Subcontractor shall respond to notices of issues identified during the commissioning process, making required corrections or clarifications and returning prompt notification to the Commissioning Authority according to the process given in Division 01 Section "General Commissioning Requirements".

.6 When completion of a task or other issue has been identified as holding up any commissioning process, particularly functional testing, the Subcontractor shall, within two (2) days of notification of the issue, notify the Commissioning Authority in writing providing an expected date of completion. The Subcontractor shall notify the Commissioning Authority in writing within one day of completion. It is not the responsibility of the Commissioning Authority to obtain this status information through meeting attendance, asking questions or field observation

.7 Construction Checklists. The Commissioning Authority or Subcontractor shall develop checklists as noted in the list of commissioned systems in Division 01 Section "General Commissioning Requirements", following the process described in Division 01 Section "General Commissioning Requirements" and in this Section. At a minimum, for a given piece of equipment, checks from the inspection checklists in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems shall be included in the electrical checklists. The Subcontractor shall execute and document all checks.

.8 Check and testing procedure and startup plan development and execution responsibilities are described in the Check and Testing Responsibility Table in the supplements to Division 01 Section "General Commissioning Requirements".

.9 The Subcontractor shall review design documents, shop drawings and O&M manuals and manufacturer recommended installation and testing procedures of each system installation.

.10 The Subcontractor shall monitor installation to ensure the equipment, configuration and quality of construction meets the design requirements, approved submittals and shop drawings.

.11 The Subcontractor shall develop test procedures and forms and execute and document testing according to the requirements of this Section, Division 01 Section "General Commissioning Requirements" and other specification sections containing testing requirements.

.12 Tests of energized equipment shall be conducted when the equipment is operating at its normal capacity. This may require some tests to be conducted after occupancy.

.13 Monitoring Based Commissioning.

.1 The CxA will develop MBCx procedures and document them in the Commissioning Plan.

.2 The subcontractors will install and calibrate all metering and sensor devices according to the manufacturer’s instructions. Defective devices will be recalibrated or replaced.

.3 The Controls Subcontractor will setup all required BAS points, trend logs, graphs, reports and other items as may be required to support the MBCx effort.

.4 For a period of one year after occupancy, the City or Contract Administrator will review building operation and trend logs (typically monthly) to confirm proper operation of the building systems. Any need for re-training of the City's staff or operations team will also be identified.

.5 Deficiencies will be documented in the issues log and will be corrected by the responsible subcontractor at no additional cost to the City. The issues log will be reviewed by the City, Contractor and subcontractors, and CxA.

.6 Re-Training. The MBCx effort may identify the need for re-training. The responsible subcontractor and/or vendor will provide re-training at no additional cost to the City.

.14 Training and Orientation. The Subcontractor shall follow the facility staff orientation and training requirements as described in Division 01 Section "Demonstration and Training" and other applicable technical sections.

.15 Operation And Maintenance (O&M) Manuals. Refer to Division 01 Section "Closeout Procedures," Division 01 Section " General Commissioning Requirements," and Division 26 Section "General Requirements" for requirements for O&M manuals.

4 Equipment-Specific Verification and Testing Requirements

4.1 SUMMARY

.1 This Part specifies the check and testing requirements for electrical components and systems. From these requirements, the Commissioning Authority or Subcontractor will develop detailed procedures and forms. The general testing process, requirements and test method definitions are described in Division 01 Section "General Commissioning Requirements".

4.2 CHECKS AND TESTS

.1 Checks are intended to begin upon completion of a component or equipment installation. Testing generally occurs later when systems are energized or nearing that point. Beginning system testing before full completion, does not relieve the Subcontractor from fully completing the system as soon as possible, including all construction checklists and may require retesting portions of the system once all components are fully functioning.

.2 Refer to Division 01 Section "General Commissioning Requirements" for specific details on non-conformance issues relating to construction checklists and tests. Refer to Division 01 Section "General Commissioning Requirements", for common requirements of deferred testing and to articles in this Section.

.3 The check and test procedures and record forms shall contain the following:

.1 The Subcontractors executing the checks or tests.

.2 A list of the integral components being inspected and tested, equipment tag numbers, manufacturer, model number, pertinent performance information / rating data.

.3 Test equipment used.

.4 Construction checklists associated with the components, if any.

.5 Any special required conditions of the check or test for each procedure.

.6 Items, conditions or functions to be inspected, verified or tested, the checks and testing method given and a place provided with results recorded.

.7 Acceptance criteria (or reference by specific table where the acceptance criteria is found).

.8 For each procedure, list the technician performing check or test and company, witnesses of the tests and dates of tests.

.9 Sampling strategies used.

.4 The test procedures for dynamic equipment like lighting controls, emergency generator or fire alarm shall contain more step-by-step procedures with expected responses similar to the sample test provided as a supplement to Division 01 Section "General Commissioning Requirements". The test procedures and forms for more static components like panel boards, switch gear, circuit breakers, transformers, etc., can be more checklist-like in format. For each piece of equipment, checks and test procedures and their documentation record forms may be different documents or combined in the same document, but checks and tests should be grouped.

.5 At the Commissioning Authority's discretion, if large numbers or repeated deficiencies are encountered, the Subcontractor shall test and troubleshoot all remaining systems at issue on their own before commissioning with the Commissioning Authority will resume.

.6 Sampling for Identical Units. When there are a number of identical units, at the Commissioning Authority’s discretion, some or all procedures of a test for a piece of equipment or assembly may be omitted when these same tests on other pieces of identical equipment or assemblies were conducted without deficiency.

4.3 EQUIPMENT-SPECIFIC TESTING REQUIREMENTS

.1 The following paragraphs define the testing requirements for each type of system or feature that is a part of the project. The Commissioning Authority shall use this information to develop specific testing procedures for each of the systems to be commissioned. The Subcontractor shall be responsible for support, execution and coordination of these tests as described in the project specifications including intersystem tests and interlocks with systems in Divisions other than Division 26.

.2 The Commissioning Authority and Subcontractor shall coordinate with the project LEED coordinator to verify that LEED requirements for testing electrical systems are included in the tests.

.3 Common Testing Requirements

.1 The following requirements apply to all electrical systems and features that are to be commissioned when referenced below. Tests shall:

.1 Verify functionality and compliance with the design intent for each individual sequence module in the sequences of operation. Verify proper operation of all control strategies, energy efficiency and self-diagnostics features by stepping through each sequence and documenting equipment and system performance. Test every step in every written sequence and other significant modes, sequences and operational features not mentioned in written sequences; including startup, normal operation, shutdown, scheduled on and off, unoccupied and manual modes, safeties, alarms, over-rides, lockouts and power failure.

.2 Verify all alarm and high and low limit functions and messages generated on all points with alarm settings.

.3 Verify integrated performance of all components and control system components, including all interlocks and interactions with other equipment and systems.

.4 Verify shut down and restart capabilities both for scheduled and un-scheduled events (e.g. power failure recovery and normal scheduled start/stop).

.5 When applicable, demonstrate a full cycle from off to on and no load to full load and then to no load and off.

.6 Verify time of day schedules and setpoints.

.7 Verify all energy saving control strategies.

.8 Verify that monitoring system graphics are representative of the systems and that all points and control elements are in the same location on the graphic as they are in the field.

.9 Verify operator control of all commandable control system points including proper security level access.

.10 When testing procedures for commissioned equipment are listed in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems the NETA test procedures shall be part of the testing requirements of this specification. Additional testing procedures may be listed in this specification.

.11 Common Acceptance Criteria

.2 The following common acceptance criteria apply to all mechanical equipment, assemblies and features:

.1 For the conditions, sequences and modes tested, the equipment, integral components and related equipment shall respond to varying loads and changing conditions and parameters appropriately as expected, according to the sequences of operation, as specified, according to acceptable operating practice and the manufacturer's performance specifications. Verify that equipment operates within tolerances specified in: governing codes, acceptance criteria contained in the construction documents, manufacturer's literature and according to good operating practice.

.2 Systems shall accomplish their intended function and performance.

.3 All safety trips shall require a manual reset to allow a system restart.

.4 Resetting a manual safety shall result in a stable, safe, and predictable return to normal operation by the system.

.5 Safety circuits and permissive control circuits shall function in all possible combinations of selector switch positions (hand, auto, inverter, bypass, etc.).

.6 Other acceptance criteria is given in the equipment testing requirements articles or referenced standards.

.7 Additional acceptance criteria will be developed by the Commissioning Authority when detailed test procedures are developed.

.8 When testing procedures for commissioned equipment are listed in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems the NETA performance criteria shall apply.

.4 Equipment-Specific Testing Requirements:

.1 Scheduled Lighting Controls.

.1 Apply the applicable common testing requirements and acceptance criteria.

.2 Test Methods. Utilize active testing, and trending when available. If able to trend, trend all zones over a week period and follow the trending guidelines in Division 23 Section "Commissioning of HVAC".

.3 Sampling Strategy. Manually test 20 percent of the zones or at least four. If more than 10 percent or two zones fail, test another 10 percent sample. If the second sample fails the Subcontractor shall document retesting on all zones on their own using a Commissioning Authority approved form.

.2 Occupancy Sensor Lighting Controls.

.1 Apply applicable common testing requirements and acceptance criteria. Test all units functions, including sensor sensitivity and time-to-OFF functions and ensure that sensor location is proper and won't be tripped inadvertently by other occupants and movements outdoors, etc.

.2 Sampling Strategy. Test 10 percent of the sensors or six, whichever is greater. If more than 10 percent or two sensors fail, test another 10 percent sample. If the second sample fails the Subcontractor shall document retesting on all units on their own using a Commissioning Authority approved form.

.3 Additional Acceptance Criteria. Reasonable sensitivity, no inadvertent trips, lights go off within 15 seconds of design.

.5 Test Methods. Utilize active test methods.

.1 Emergency Generator System

.1 Apply applicable common testing requirements and acceptance criteria.

.2 Test according to NETA 7.22.1 and NFPA 110 5.13 and per Division 01 Section "Special Procedures."

.3 Record all data and results.

.4 Include the following tests:

.1 When in enclosed spaces, verify combustion and ventilation air damper functions and pressure drop of exhaust.

.2 Verify fuel oil system, diesel fuel storage tank, and level and low fuel indication alarms.

.3 Verify all alarms, meters, and auxiliaries and interlocks to the BAS.

.5 Building Test. Under a cold generator condition, provide full utility power interruption under load and cause emergency power service operation. Include all UPS in this test. Load bank the UPS if necessary during test.

.6 Verify all generator functions

.7 Test auto-transfer switch operation under actual voltage drop, per specification Division 26 Section "Automatic Transfer Switch with Bypass-Isolation Feature".

.8 Using a power line disturbance monitor, measure the following times: power failure to engine start command, engine start command to engine start (cranking time), engine start to point where generator is at proper volts and frequency and total time from power failure until ATS switches.

.9 Verify system reporting & control monitoring point-to-point

.10 Verify that each circuit and equipment served by emergency power, does power up. Verify all functions of the Emergency Power Response Matrix.

.11 Verify appropriate mechanical system and control system restart functions of all equipment served by the generator.

.2 Step Load Tests.

.1 Test at 0 percent, 25 percent, 50 percent and 100 percent of full load. Measure voltage and frequency and record all gaged engine conditions. The test shall consist of running the engine-generator while connected to the resistive load bank for one hour, and then shutting down for 30 minutes.

.2 Test for multiple generator starts.

.3 Verify all operational data and start-up minimum time interval.

.4 Verify 2-hour full load run full load bank (building load can serve as part of the load).

.5 Verify all generator-running characteristics.

.6 Verify battery-charging system.

END OF SECTION

1 General

1.1 SCOPE

.1 The pad-mounted transformers for building and chargers have been pre-purchased by the City as part of long lead delivery items.

.2 Contractor shall install the transformers supply ancillary electrical materials to complete the installation. The transformers shall be free issue to the Contractor.

1.2 SUBMITTALS (NOT APPLICABLE)

.1 Submit shop drawings for products specified in this Section.

.2 Shop drawings shall indicate clearly the materials and/or equipment actually being supplied, all details of construction, accurate dimensions, capacity, operating characteristics and performance. Each shop drawing shall give the identifying number of the specific piece of equipment etc. for which it was prepared

.3 Each shop drawing or catalogue sheet shall be stamped and signed by the Contractor to indicate that it has checked the drawing for conformance with all requirements of Contract Documents including the Contract Drawings, that it has coordinated equipment included on the shop drawings with other equipment to which it is attached and/or connected thereto and that it has verified all dimensions to ensure the proper installation of equipment within the available space and without interference with the work of other trades.

.4 Indicate:

.1 Dimensioned positions of mounting devices.

.2 Dimensioned positions of terminations.

.3 Identified internal and external component layout on assembly drawing.

.4 Insulating liquid capacity.

.5 Complete set of instruction manual.

.6 Submit operation and maintenance manuals.

.7 Include the following information in the Operation and Maintenance manuals:

.1 Names and address of local suppliers for the items included.

.2 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation.

.3 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature is not acceptable.

.8 Review information provided in the maintenance instructions and manuals with the The City's operating personnel to ensure a complete understanding of the electrical equipment and systems and their operation.

.9 Provide maintenance data for liquid cooled transformers for incorporation into manual

.10 Include insulating liquid maintenance data.

.11 Manufacturer must provide complete factory tests, signed by a professional Engineer to the customer for approval before shipping.

.12 Ship transformers complete with first fill of liquid.

.13 Continuously check and expedite delivery of equipment and materials.

.14 As required, inspect equipment, etc. at the source of manufacture.

1.3 LOCAL ELECTRICAL UTILITY AND AUTHORITY REQUIREMENTS

.1 Confirm local electrical utility requirements, obtain required standards and include for applicable general requirements as follows:

.1 necessary submissions and notifications to local electrical utility to obtain required inspections, approvals and certifications;

.2 enclosure design considerations to include relevant factors such as controlled access, tamper-resistance, and for outdoor applications weather-proofing and corrosion resistance, in compliance with local electrical utility requirements;

.3 steel hinged doors with locking provisions in compliance with local electrical utility requirements;

.4 lightning surge arrestor protection and grounding and bonding in compliance with local electrical utility requirements;

.5 nameplates and warning signs as per local governing electrical utility and other local authority and code requirements;

.6 guard posts (bollards) to protect units as per local electrical utility requirements;

.7 leak containment requirements as per local governing electrical utility and other local authority and code requirements;

.8 compliance with local electrical utility requirements and local inspection authorities prior to energization of equipment.

2 Products (For Reference Only)

2.1 PAD MOUNTED TRANSFORMER – REFER TO SCHEDULE FOR QUANTITY AND TYPE

.1 Type ONAN 12.47 kV, 3-phase, 4-wire, 60 cycle AC delta primary, 347/600 volt, 3-phase, 4-wire, 60 cycle AC wye low voltage secondary for Building Transformer, 277/480V 3-phase, 4-wire, 60 cycle AC wye low voltage secondary for Charger Transformer outdoor weatherproof pad mount transformer. Transformers to be CSA approved and/or ULC listed and labelled. transformer to be oil liquid immersed, designed, manufactured and complete with manufacturer's standard features and accessories in accordance with requirements herein specified and as per listed codes and standards. Transformers to comply with latest requirements of following codes and standards:

.1 CSA C227.4 UPD 2 Three-phase, pad-mounted distribution transformers with separable insulated high-voltage connectors;

.2 ANSI/IEEE C57.12.34, IEEE Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 10 MVA and Smaller; High-Voltage, 34.5 kV Nominal System Voltage and Below; Low-Voltage, 15 kV Nominal System Voltage and Below;

.3 ANSI/IEEE C57.12.22 Transformers - Pad-Mounted, Compartmental-Type, Self-Cooled Three-Phase Distribution Transformers With High-Voltage Bushings, 2500 kVA and Smaller: High Voltage, 34 500 Grd Y/19 920 Volts and Below; Low Voltage, 480 Volts and Below;

.4 Natural Resources Canada, Canada Energy Efficiency Act, Energy Efficiency Regulations, SOR/2016 – 311 Amendment 14 and ON Reg.404-12 – effective as of Jan. 1, 2018;

.5 DOE 2016 – U.S. Department of Energy, Energy Conservation Program; Distribution Transformers Energy Conservation Standards DOE 10 CFR Part 431. Revised Apr. 2013 - effective Jan. 1, 2016;

.6 applicable local governing authority codes and standards.

.2 Capacities for transformer are shown on drawings, at 65C° (117F°) temperature rise above 40°C (104°F) ambient, without fans. Transformers to be capable of additional 33% capacity output when equipped with fans.

.3 Transformer to be outdoor sealed type, completely tamper proof with features as follows:

.1 enclosure design considerations to include relevant factors such as controlled access, tamper-resistance, weather-proofing and corrosion resistant;

.2 pad-lockable hinged doors and removable panels over high voltage and low voltage bushings, gauges, relief valves and ancillary devices;

.3 access to each compartment to be provided by hinged door with a minimum 5 pin type hinge with 3 pentahead bolts; no other exposed hardware or fastening devices;

.4 doors and panels to be constructed from heavy gauge hot-rolled, sheet steel;

.5 controls enclosure to be minimum NEMA 3R rated, finished in corrosion resistant weatherproof ANSI green enamel;

.6 suitable for mounting onto concrete pad as detailed.

.7 complete with primary and secondary cable compartments.

.8 high voltage bushing wells for dead front operation

.9 spade type low voltage terminals

.10 copper windings for high voltage and low voltage windings

.11 Bay-o-net expulsion fuses

.12 Separate accessible low voltage compartment for connection of overhead cable bus or bus duct.

.4 Sound level for transformer to be in accordance with CSA Standard CAN3 C88.

.5 Basic impulse level (BIL) for transformer to be 95 kV BIL at 12.47 kV.

.6 Impedance for transformers to be within range from 6.0% to 6.5%, +/- CSA tolerances. Each supplied transformer to have same matching impedances.

.7 Efficiency of transformers to be greater than 98%.

.8 Tank:

.1 Transformer tank to be sealed, constructed of high quality steel plate with electrically welded seams, tank wall stiffening reinforcing members and a structural steel I-beam base.

.2 Tank to include a welded-on or bolted-on tank coverplate with an inspection and maintenance handhole and bolt-on cover, lifting lugs, jacking facilities and stainless steel grounding pads.

.3 Components to include a bottom oil drain and sampling valve, a hermetically sealed liquid level gauge with low level alarm contacts, a high winding temperature alarm and alert contacts for connection to a remote alarm, a hermetically sealed dial type liquid temperature thermometer and a pressure vacuum gauge.

.4 Tank to also be complete with an integral tank high pressure relief device with hood for deflecting away from controls and a padlockable tamperproof cover.

.5 Tank to be cleaned, primed and finished with oil resistant paint on inside, and outside with primer and overcoat oil-based equipment enamel.

.9 Cooling Tubes:

.1 Cooling tubes on each side of transformer to consist of external flattened profiled pressed plate seam welded and welded to header pipes.

.2 Cooling tubes to be suitable for operation with fans which are to be controlled by oil temperature thermostat.

.10 Liquid Fill:

.1 Mineral insulating oil in conformance with latest edition of CAN/CSA No. C50, readily obtainable, compatible with transformer insulation and meeting CSA C50 requirements as to viscosity, breakdown voltage, and chemical purity. Fluid features include:

.1 easy to re-process/dispose;

.2 biodegradable and low toxic;

.3 minimum open cup flash point of $\geq$145°C (293°F) and a fire point of $\geq$165°C (329°F).

.2 Provide required liquid fill.

.11 Core & Coil Assembly:

.1 Core to be constructed from grain oriented electrical grade silicone steel and be designed using a maximum 1.7 Tesla, designed for low in-rush current less than 6 times rated current and for low excitation current of less than 1% at rated voltage.

.2 Core and coil assembly to be rigidly braced, shock and vibration resistant. Windings to be insulated copper. Coil to be insulated with insulation suitable for a 65C° (117F°) temperature rise. Coil to consist of thermally upgraded paper insulated copper coil windings, wound with adequate bracing and blocking to minimize effects of short circuit. Insulation is provided on outer layers of primary windings along with proper mechanical bracing between winding sections. Coil windings to be constructed of 99.9% high conductivity copper.

.3 Utilize pressboard with stand voltage, dielectric constant, aging characteristics, low shrinkage, and bending properties suitable for specific applications for high-low barriers and yoke and tank shields.

.4 Allocate duct strips with high compressive strength, low power factor at high temperatures and excellent transformer liquid impregnation, evenly throughout windings to allow for uniform heat dissipation.

.5 Primary voltage taps to consist of four (4) 2-1/2% full capacity off load taps, two (2) FCAN and two (2) FCBN, operated by a non-load tap changer with operating lever located outside tank. Lever to include position indicator and padlocking provisions. Terminal boards to be provided with core and coil assembly for primary and secondary leads and taps.

.12 Connection Facilities:

.1 Separate transformer primary and secondary connection facilities to be provided to suit design requirements of manufacturers of individual connected equipment.

.2 Include CSA approved primary connectors for TECK primary cables.

.3 Include spade type connections for secondary connections.

.4 High voltage bushings: to EEMAC L9-3

.5 Provide sidewall mounted throat with C2 class primary bushings within a tamperproof air terminal chamber extended to grade level.

.6 Provide sidewall mounted throat secondary bushings with a tamperproof air terminal chamber extended to grade level.

.7 XO to be brought out to a separate bushing and grounded externally.

.8 Bay-o-net fuses in load break dry well to be sized as per transformer rating

.13 Additional Requirements:

.1 Windings, core, frames, and other parts of transformers to be designed, constructed and braced to prevent change in shape or displacement, or movement in handling, and to withstand surges, short circuits or any other electrical conditions which may develop.

.2 Core and windings to be vibration isolated from frames with neoprene pads or equivalent means.

.3 Sudden pressure gas relay to operate on rate of change of internal pressure and with contacts to trip secondary breakers as required and as confirmed with Contractor Administrator.

.4 Spring isolation type anti-vibration mountings between I-beam base and concrete floor pad, to isolate not less than 90% of disturbing vibrations.

.5 Structural I-beam steel base assembly.

.6 Ohio Brass station/intermediate/distribution class polymer metal oxide varistor (MOV) lightning arrestors to suit application; lightning arrestors to be rated for system voltage rating; maximum continuous operating voltage (MCOV) to be as per manufacturer's recommendations.

.7 Internal current limiting fuses.

.8 Each transformer to be complete with heavy gauge (minimum No. 16 USS gauge) galvanized steel drain pan sized to contain complete liquid fill of transformer, reinforced with galvanized steel angles, continuous welded joints, galvanized steel pipe drain connection with 50 mm (2") hose end drain valve and pan bottom sloped to drain connection. Exterior of pans to be heavy coated with suitable primer. Interior of pans to be heavy coated with bituminous paint.

.9 Metal nameplate permanently affixed on each transformer clearly showing information as per CAN/CSA C88 requirements.

.10 Warning signs to local governing authority and code requirements.

.14 Testing, Start-up, Verification and Training:

.1 Perform standard factory testing and submit copy of detailed reports to Contractor Administrator for review.

.2 Assist installing Contractor in installation of equipment and to inspect installation, test equipment, perform start-up and verify equipment. Coordinate work with Contractor.

.3 Perform testing at times reviewed with Contractor Administrator.

.4 Provide instructions on system operating and maintenance.

.15 Acceptable manufacturers:

.1 Northern Transformers.

.2 Asea Brown Boveri.

.3 Schneider Electric.

.4 Siemens Electric.

.5 Pioneer Transformers.

.6 Eaton/ Cooper Power Systems.

.7 PTI Transformers

3 Execution

3.1 INSTALLATION OF PAD MOUNTED TRANSFORMERS

.1 Installation and necessary terminations to be performed by firms specializing in this type of work as listed in Part 2.

.2 Provide units into locations. Base layout, design, connections and supplied accessories from documents and reviewed shop drawings. Carefully examine drawings and site conditions to ensure that equipment can be positioned into their designated positions, without difficulty. Ensure adequate clearance is provided as per code requirements and as required for access for operation and maintenance.

.3 Coordinate provision of leak containing requirements with General Trades Contractor.

.4 Where transformers are integrated to substation structure, assemble sections in accordance with manufacturer's recommendations and instructions, and secure assembly to concrete base. Ensure that bus joint bolts are torqued to manufacturer's instructions.

.5 Secure transformers to bases using spring type isolation pads with minimum 13 mm (1/2") deflection, and additional seismic restraints requirements to suit local governing codes and authorities. Where connecting conduits are used, utilize liquid type flexible metallic conduits.

.6 Provide seismic restraints as required by local governing authorities and codes. Where connecting conduits are used, utilize liquid type flexible metallic conduits.

.7 Install controls and metering displays at height between 1200 mm (4') and 1800 mm (6') above finish floor level.

.8 Arrange for transformer manufacturer to provide necessary drawings for installation. In addition, if required, obtain from manufacturer necessary copies of detail drawings, testing results, etc., required for approval of transformer and installation work from Utility and any other local authority having jurisdiction. Obtain required approvals and certificates.

.9 Provide alarm/communications circuits as required. Include for provision of conduits, boxes and control/signal wiring for interconnection to BAS. Coordinate with Mechanical Divisions BAS Contractor on location of BAS panel to be used for monitoring points and extend wiring in conduit from electrical equipment to location. Terminate in junction box leaving 3 m (10') of slack length of wiring (exact length to be coordinated between Mechanical and Electrical trades), for extending and termination to BAS panel by Mechanical Division BAS Contractor. Properly identify wiring and junction box.

.10 Make necessary incoming and outgoing power cable connections to equipment in strict accordance with equipment and cable manufacturer's recommendations. Ensure connections, stress cones and terminations are suitable for specific incoming and outgoing cables. Where applicable, obtain bus duct flange from bust duct manufacturer and install to connect to bus duct, as required.

.11 Ground and bond equipment to ground electrode grids as per local governing electrical code and inspection authority requirements. Refer also to requirements of grounding and bonding article.

.12 Check transformer liquid level prior to energization. Top up if necessary.

.13 Test power transformers before placing in regular service. Testing work to include voltage ratio test, phase angle test, insulation resistance, liquid sample testing, verification and any testing as required by local authorities.

.14 Provide engraved Lamacoid nameplates and warning signs with nomenclature reviewed with Contractor Administrator.

.15 Transformers with fans are to be protected with fencing or other means as per local governing authority or code requirements.

.16 Additionally, refer to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

END OF SECTION

1 General

1.1 SCOPE

.1 The high voltage disconnect switch and fuses have been pre-purchased by the City as part of long lead delivery items.

.2 Contractor shall install the high voltage electrical equipment and supply ancillary electrical materials to complete the installation. The high voltage equipment shall be free issue to the Contractor.

1.2 RELATED SECTIONS

.1 Specific reference is made to the following sections:

.1 Section 01 33 00, Submittal Procedures

.2 Section 26 05 00, Basic Electrical Materials and Methods

1.3 CODES AND STANDARDS

.1 General:

.1 Primary Standards:

.1 CSA C22.1-24, Canadian Electrical Code, Part I - Safety Standard for Electrical Installations

.2 City of Winnipeg, Electrical Bylaw No. 104

.2 High Voltage Switch:

.1 Primary Standards:

.1 IEEE C37.30 High Voltage Air Switches, Insulators and Bus Supports

.2 IEEE C37.32 Preferred Rating, Manufacturing Specifications and Application Guide for High Voltage Air Switches, Bus Supports and Switch Accessories.

.3 IEEE C37.34 Standard Test Code for High Voltage Air Switches.

.3 High Voltage Fuse:

.1 Primary Standards:

.1 IEEE C37.41 IEEE Standard Design Tests for High Voltage (>1000V) Fuses and Accessories.

.2 IEEE C37.42 IEEE Standard Specifications for High Voltage (>1000V) Fuses and Accessories.

.3 IEEE C37.48 IEEE Guide for the Application, Operation, and Coordination of High Voltage (>1000V) Current Limiting Fuses.

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00, Submittal Procedures and Section 26 05 00, Basic Electrical Materials and Methods. Documents shall be submitted in the quantities and formats required by Section 01 33 00, Submittal Procedures.

.2 Product Data:

.1 Provide Manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, and limitations.

.3 Submit the following documents:

.1 As part of the tender package submission, provide:

.1 Preliminary drawings of high voltage disconnect switch and fuse assembly showing:

.1 Dimensioned layout and elevations indicating operating clearances.

.2 Dimensions and weights including total weight and shipping weights,

.2 Preliminary schedule for the design, approval, manufacture, test and delivery to Site.

.3 Proposed delivery plan including:

.1 Method of transport,

.2 Condition monitoring requirements (impact recorder, pressurization monitor),

.3 Listing of items to be shipped loose.

.4 Approval Documents and Drawing

.1 Approval Documents and Drawings

.1 Provide the following approval drawings to be submitted shall include, but not be limited to the following:

.1 Dimensioned layout and elevations indicating operating clearances.

.2 Operating handle installation details.

.3 Disconnecting mechanism, switching type, mounting design.

.4 Interlocking schemes and connection details.

.5 Nameplate data,

.6 Ratings including voltage, continuous current, momentary current and impulse.

.7 Confirmed dimensions and weights,

.8 Connection, wiring and terminal block diagrams.

.9 Instructions for field installation, assembly and disassembly.

.10 Instructions for operating and maintenance of the equipment and accessories.

.11 Instructions for installing key interlocks.

.12 Instructions for equipment start-up and operation, calibration procedures, operational adjustments and troubleshooting.

.13 Instructions and schedule for routine and preventative equipment maintenance, to assure meeting specified equipment service life time.

.14 Detailed bill of materials including names of manufacturers and catalogue number of all components including replacement parts.

.15 FAT procedures for all equipment.

.16 Complete technical information and supplier data sheets for major items to be supplied.

.2 Drawings for approval shall be submitted within eight (8) weeks after award of Contract in the quantities and formats required by Section 01 33 00, Submittal Procedures.

.2 A detailed manufacturing schedule shall be submitted within four (4) weeks after award of Contract. The Schedule shall detail each activity with start and finish dates, duration, etc. for each step of the design, manufacturing, factory and witness testing, delivery, site assembly, testing, and commissioning of the switch.

.3 Test Plans:

.1 Provide a complete factory inspection and test plan for review and approval within twelve (12) weeks after award of Contract.

.2 Provide notification in advance of all tests and inspections. Provide fourteen (14) days notice advance notice for tests and inspections during manufacturing, and twenty-one (21) days for final witness testing.

.3 Test data and reports shall be submitted within seven (7) days after completion of tests.

.4 Submit final test reports for acceptance prior to the units being shipped.

.5 “As-Manufactured” drawings shall be submitted a minimum of fourteen (14) days prior to the scheduled shipping date. Final “As-Manufactured” package shall be submitted in the quantities and formats required by Section 01 33 00, Submittal Requirements.

.5 Closeout Submittals:

.1 Provide submittals in accordance to Section 01 78 00 – Closeout Submittals.

.2 Operation and Maintenance (O&M) manual(s) shall be provided the quantities and formats required by Section 01 78 23, Operation and Maintenance Data.

.3 The O&M manual shall include, but not limited to, the following:

.1 Production test certificates signed by Manufacturer certifying that materials comply with specified performance characteristics and physical properties,

.2 Certified copies of reviewed test data and reports,

.3 Certified, Signed and Approved drawings,

.4 Product submittals,

1.5 MAINTENANCE

.1 Provide a recommended tools and spare parts list as required by Section 01 33 00, Submittal Procedures.

1.6 OPERATING CONDITIONS

.1 Provide all necessary safeguards and protection for optimal performance of the equipment.

.1	Location:	Outdoors
.2	Temperature:	-40°C to 40°C
.3	Relative Humidity:	20% to 100%
.4	Elevation:	239 m ASL
.5	Duty:	24 hours/day, 365 days/year.

2 Products

2.1 HIGH VOLTAGE DISCONNECT SWITCH CHARACTERISTICS

.1 Ratings

.1 High voltage disconnect switch shall be designed to operate satisfactorily for the following minimum basic electrical parameters:

.1	Nominal Voltage:	66 kV
.2	Rated Maximum Voltage:	72.5 kV
.3	Current Rating:	1200 A
.4	Nominal Frequency:	60 Hz
.5	Basic Insulation Level:	350 kV
.6	Short Circuit Withstand:	Min. 50 kA (for 3 seconds)

.2 The equipment will be installed outdoors in a switchyard. The disconnect shall be a three-pole vertical break, three insulators, gang operated, single throw switch complete with quick-break arcing horn, a manual gear operating handle and auxiliary contacts (4 N.O. / 4 N.C.).

.3 Mounting hardware shall be provided as required for mounting the disconnect.

.4 The disconnect switch terminal pads shall be provided with 4-hole NEMA aluminum terminal pads.

.5 The manual gear operated handle shall be complete with appropriate couplings, shafts, pipes, lag screws, bolts, etc. required to install the disconnect in accordance with drawings. The manual gear operated handle shall include provision for installing key interlock.

.6 The disconnect switch shall include an adjustable blade stop for the disconnect switch blade and adjustable stops for the control mechanism.

.7 All required hardware shall be hot dip galvanized as per ASTM A123.

.8 All non-energized metallic components of the disconnect shall be grounded.

.9 Ground lugs sized for connection to a 4/0 AWG stranded bare copper grounding conductor shall be provided to ground all non-energized metallic components of the disconnect switch.

.10 Approved Equipment Manufacturer:

.1 Southern States, S & C, Mind Core, Cleaveland-Price or approved equal.

2.2 HIGH VOLTAGE FUSE CHARACTERISTICS

.1 Expulsion Fuse Ratings

.1 High voltage power fuse shall be designed to operate satisfactorily for the following minimum basic electrical parameters:

.1	Nominal Voltage:	69 kV
.2	Rated Maximum Voltage:	72.5 kV
.3	Current Rating:	300E
.4	Nominal Frequency:	60 Hz
.5	Basic Insulation Level:	350 kV
.6	Interrupting Rating (Sym.):	17.5 kA

.2 The equipment will be installed outdoors in a switchyard. The power fuse shall be three phase, vertical mounting with 180° opening and 150E fuse unit (standard speed). Provide three (3) spare 150E fuse unit. Each phase shall be individually mounted on the wood pole.

.3 The power fuse terminal pads shall be provided with 4-hole NEMA aluminum terminal pads.

.4 All required hardware shall be hot dip galvanized as per ASTM A123.

.5 All non-energized metallic components of the disconnect shall be grounded.

.6 Ground lugs sized for connection to a 4/0 AWG stranded bare copper grounding conductor shall be provided to ground all non-energized metallic components of the power fuse.

.7 Approved Equipment Manufacturer:

.1 S & C Electric SMD-2B or approved equal.

.2 Current-Limiting Fuse Ratings

.1 High voltage current-limiting fuse shall be designed to operate satisfactorily for the following minimum basic electrical parameters:

.1	Nominal Voltage:	38 kV
.2	Rated Maximum Voltage:	69 kV
.3	Current Rating:	100 kA
.4	Nominal Frequency:	60 Hz
.5	Basic Insulation Level:	350 kV
.6	Rated Max. Interrupting:	20 kA

.2 The equipment will be installed outdoors in a switchyard. The current-limiting fuse shall be mounted on base plate and polymer insulator standoff as part of the fuse assembly. Each phase shall be individually mounted on the wood pole.

.3 The current-limiting fuse terminal pads shall be provided with wedge aluminum connector bolted to the terminal pads.

.4 All required hardware shall be hot dip galvanized as per ASTM A123.

.5 All non-energized metallic components of the disconnect shall be grounded.

.6 Ground lugs sized for connection to a 4/0 AWG stranded bare copper grounding conductor shall be provided to ground all non-energized metallic components of the power fuse.

.7 Approved Equipment Manufacturer:

.1 ABB Trans-Guard EXT or approved equal.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Basic Electrical Materials and Methods, and as indicated on the Datasheet.

.2 Provide metallic (stainless steel) Nameplate (Rating Plate) on the outside of the base plate.

.3 Nameplates and equipment tags shall be in accordance with the requirements of Section 26 05 00.

.4 Nameplates shall be attached by means of rivets, drive pins, or self-tapping screws. Note that the use of “sheet metal” or other screws having sharp points is NOT acceptable.

.5 Submit a detailed list of all proposed nameplates and equipment tags for review prior to fabrication.

2.4 SOURCE QUALITY CONTROL

.1 Submit to the Contract Administrator standard factory test certificates for each material in accordance with Specification Section 26 08 05, General Electrical Requirements - Electrical.

.2 All inspection and testing shall be carried out at the Vendor's works and shall be available for witnessing and approval by the The City's representative. Vendor shall maintain an inspection and test plan and quality assurance manual for review and acceptance. The plans shall specify each characteristic to be verified: the requirements, the amount of inspection or testing, and the organizational element responsible for performing the inspections. Preference shall be given to Vendors that have a quality system certified to ISO 9001.

.3 Factory Acceptance Tests (FAT) shall be conducted in the presence of the Contractor. FAT shall be scheduled at least four (4) weeks prior to shipping and with a minimum of three (3) weeks' notice

.4 Manufacturing tests for disconnect switch shall be conducted in accordance with the provisions of IEEE C37.34 and shall include, as a minimum, the following tests

.1 Power-frequency withstand voltage tests.

.2 Switch performance tests.

.3 Mechanical operations test.

.5 Insulators shall be designed in accordance with ANSI C29.1 requirements.

.6 Provide certified test reports for each unit as part of the operations and maintenance manual.

.7 Provide type test reports as required.

2.5 PREPARATION FOR SHIPMENT

.1 Nameplates and Identification Tags

.1 Each major piece of equipment shall have a IEEE compliant standard nameplate securely affixed in a conspicuous place, showing the following information.

.1 Manufacturer's name and address.

.2 Purchaser's equipment number.

.3 Model number.

.4 Serial number.

.5 Mass of Equipment.

.2 Other information the manufacturer and The City may consider necessary to complete identification of the equipment.

.2 Assembly, Packaging and Shipping Instructions

.1 All components shall be completely assembled and match marked, as required, at the Vendor's assembly area prior to shipment.

.2 Preparation for Shipment

.1 Surfaces requiring protection shall be coated with suitable rust preventive material. After coating, spare parts shall be wrapped in heavy moisture-proof paper.

.2 All flanges shall be coated with a suitable rust preventive material and covered with a full-size steel cover, ¼ in. (6 mm) minimum thickness, with rubber gasket and bolted in place by a minimum of four full size bolts. All drilled and tapped holes shall be plugged with steel bar stock plugs. All other exposed pipe ends shall be capped. Plastic plugs are not allowed.

.3 Miscellaneous parts shall be tagged or marked with the item numbers for which they are intended. All such parts shall be suitably boxed and shipped with the unit.

.4 One complete set of printed Installation, Operation and Maintenance instructions shall be packaged with the crates and shipped to the jobsite.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with Manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Inspect the high voltage disconnect switch and fuses on receipt for evidence of damage during shipping.

.2 Install equipment in accordance with Contract Documents and Manufacturer's installation instructions, coordinate work with other trades.

.3 Assemble the high voltage switch and its manual operating pipe, and power fuses on the wood poles as required in accordance with the Manufacturer's instructions and requirements.

.4 Make required external cable connections as depicted in the Drawings. Torque the terminals per Manufacturer's recommendation.

.5 Connect grounding conductor to the equipment base plate as depicted in the Drawings.

.6 High voltage disconnect switch operating handle required grounding connections to the gradient control mat system in accordance with the Drawings.

3.3 FIELD QUALITY CONTROL

.1 Pre-Commissioning Tests

.1 Demonstrate, in the presence of the The City and/or the Contract Administrator, all mechanical and electrical equipment are working properly.

.2 Submit commissioning plan to the Contract Administrator for review fourteen (14 days) before the planned commissioning date.

.3 Vendor shall assist the Contractor when performing initial testing to establish the integrity of the system with respect to:

.1 Performance of safety and protection devices.

.2 Clearances.

.3 System operation.

.4 Submit relevant equipment repair procedures to the Contract Administrator if repairable defects are identified during testing. Do not repair or use defective parts without prior approval from the Contract Administrator.

.2 Commissioning Tests

.1 Vendor shall assist the Contractor in conducting commissioning tests only after the satisfactory completion of the pre-commissioning tests, and prior to the turnover of the equipment to the The City.

.3 Start-Up and Training

.1 Provide suitable field service technician to verify all cable and wiring terminations made by others and advise The City of any errors. Start-up equipment and conduct all required tests.

.2 Vendor to provide training and demonstration to The City covering all aspects of equipment operation, maintenance, troubleshooting and controls.

.3 The Vendor shall assist the Contractor during commissioning of the disconnect switch and fuse assembly under his responsibility in the Scope.

.4 Onsite service technician shall be present for the following stages of construction:

.1 Field quality control.

.2 Equipment startup.

.3 All levels of commissioning.

3.4 WARRANTY

.1 The Vendor shall provide a complete warranty for all equipment, labor and materials for the high voltage disconnect switch and power fuses valid for a period of 2 years from the date following Substantial Completion of the Winnipeg North Garage Replacement construction contract.

END OF SECTION

1 General

1.1 SCOPE

.1 The HV pad-mount transformer have been pre-purchased by the City as part of long lead delivery items.

.2 Contractor shall install the HV pad-mount transformer and supply ancillary materials to complete the installation. The HV pad-mount transformer shall be free issue to the Contractor.

1.2 RELATED SECTIONS

.1 Specific reference is made to the following sections:

.1 Section 01 33 00, Submittal Procedures

.2 Section 26 05 00, Basic Electrical Materials and Methods

1.3 CODES AND STANDARDS

.1 General:

.1 Primary Standards:

.1 CSA C22.1-24, Canadian Electrical Code, Part I - Safety Standard for Electrical Installations

.2 City of Winnipeg, Electrical Bylaw No. 104

.3 CAN/CSA C22.3 NO. 1-20, Overhead Systems

.4 C22.2 NO. 41-22, Grounding and bonding equipment (Tri-national standard, with NMX-J-590-ANCE and UL 467)

.5 CSA-W59, Welded Steel Construction

.2 Reference Standards:

.1 IEEE 80-2013, IEEE Guide for Safety in AC Substation Grounding

.2 Transformers:

.1 Primary Standards:

.1 CAN/CSA-C88:16 (R2021), Power Transformers and Reactors

.2 IEEE Std C57.12.00-2010, IEEE Standard General Requirements for Liquid-immersed Distribution, Power and Regulation transformers

.2 Reference Standards:

.1 IEEE Std C57.12.70-2011, IEEE Standard Terminal Markings and Connections for Distribution and Power Transformers

.2 IEEE Std C57.12.80-2010, IEEE Standard Terminology for Power and Distribution Transformers

.3 IEEE, C59.19.100, Guide for the Application of Power Apparatus Bushings

.4 IEEE C57.19.00, General Requirements and Test Procedure for Power Apparatus Bushings

.5 IEEE C57.19.01, Performance Characteristics and Dimensions for Outdoor Apparatus Bushings

.6 IEEE C59.19.100, Guide for the Application of Power Apparatus Bushing

.7 IEEE C57.91, Guide for Loading Mineral Oil Immersed Transformers

.8 IEEE C57.98, Guide for Transformer Impulse Tests

.9 IEEE C57.149-2012, IEEE Guide for the Application and Interpretation of Frequency Response Analysis for Oil-Immersed Transformers

.3 Insulating Oil/Fluid:

.1 Primary Standards:

.1 ASTM D6871-17, Standard Specification for Natural (Vegetable Oil) Ester Fluids Used in Electrical Apparatus

.2 Reference Standards:

.1 IEEE Std C57.147-2008, IEEE Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers

.4 Neutral Grounding Devices/Resistors (NGR):

.1 Primary Standards:

.1 CSA C22.2 NO. 295-15, Neutral grounding devices

.2 Reference Standards:

.1 ANSI/IEEE Std 32-1972 (R1997), IEEE Standard Requirements, Terminology, and Test Procedure for Neutral Grounding Device.

.2 IEEE Std. C57.32-2015 - IEEE Approved Draft Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices.

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00, Submittal Procedures and Section 26 05 00, Basic Electrical Materials and Methods. Documents shall be submitted in the quantities and formats required by Section 01 33 00, Submittal Procedures.

.2 Product Data:

.1 Provide Manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, and limitations.

.3 Submit the following documents:

.1 Completed and signed Electrical Data Sheet, 66 kV - 12.47 kV Liquid Filled High Voltage Transformer.

.2 As part of the tender package submission, provide:

.1 Preliminary drawings of transformer showing:

.1 Description and location of major accessories,

.2 Dimensions and weights including total weight and shipping weights,

.3 Quantity of insulating fluid in liters.

.2 Information for major items to be supplied with transformer (including those listed on data sheet.

.3 Preliminary schedule for the design, approval, manufacture, test and delivery to Site.

.4 Proposed delivery plan including:

.1 Method of transport,

.2 Condition monitoring requirements (impact recorder, pressurization monitor),

.3 Transportation of insulating fluid,

.4 Listing of items to be shipped loose.

.4 Approval Documents and Drawing

.1 Approval Documents and Drawings

.1 Provide the following approval drawings to be submitted shall include, but not be limited to the following:

.1 Nameplate data,

.2 Confirmed dimensions and weights,

.3 Transformer centre of gravity,

.4 Transformer outline and shipping drawings and shipping weights,

.5 Layouts, schematics, and connection diagrams for the protection and control cabinet,

.6 Schematic and connection diagrams for the transformer auxiliary equipment,

.7 Complete technical information and supplier data sheets for major items to be supplied with the transformer (including those listed on transformer the datasheet)

.2 Drawings for approval shall be submitted within eight (8) weeks after award of Contract in the quantities and formats required by Section 01 33 00, Submittal Procedures.

.2 A detailed transformer manufacturing schedule shall be submitted within four (4) weeks after award of Contract. The Schedule shall detail each activity with start and finish dates, duration, etc. for each step of the design, manufacturing, factory and witness testing, delivery, site assembly, testing, and commissioning of the transformer.

.3 Test Plans:

.1 Provide a complete factory inspection and test plan for review and approval within twelve (12) weeks after award of Contract.

.2 Provide notification in advance of all tests and inspections. Provide fourteen (14) days notice advance notice for tests and inspections during manufacturing, and twenty-one (21) days for final witness testing.

.3 Test data and reports shall be submitted within seven (7) days after completion of tests.

.4 Submit final test reports for acceptance prior to the units being shipped.

.5 "As-Manufactured" drawings shall be submitted a minimum of fourteen (14) days prior to the scheduled shipping date. Final "As-Manufactured" package shall be submitted in the quantities and formats required by Section 01 33 00, Submittal Requirements.

.5 Closeout Submittals:

.1 Provide submittals in accordance to Section 01 78 00 – Closeout Submittals.

.2 Operation and Maintenance (O&M) manual(s) shall be provided the quantities and formats required by Section 01 78 23, Operation and Maintenance Data.

.3 The O&M manual shall include, but not limited to, the following:

.1 Production test certificates signed by Manufacturer certifying that materials comply with specified performance characteristics and physical properties,

.2 Certified copies of reviewed test data and reports,

.3 Certified, Signed and Approved drawings,

.4 Product submittals,

1.5 MAINTENANCE

.1 Provide a recommended tools and spare parts list as required by Section 01 33 00, Submittal Procedures.

2 Products

2.1 TRANSFORMER CHARACTERISTICS

.1 General Characteristics:

.1 Type and Ratings:

.1 Transformer(s) shall be 3 phase, 60 Hz, liquid-filled suitable for pad mounting. The connections, cooling, and ratings shall be as per Transformer Datasheet. The requirements of CSA-C88, Sections 5, 6 and 7 shall apply.

.2 Temperature Rise:

.1 Limits of temperature rise shall be 65 degrees C average and 80 degrees C hottest spot, above ambient as per CSA-C88, Section 9. Other provisions of that section shall also apply.

.3 Impedance:

.1 Impedance shall be expressed on the rated (KNAN) MVA base and shall be as indicated on the Datasheet.

.4 Short Circuit Capability:

.1 Transformers shall be designed in accordance with IEEE C57.12.00, with a primary short circuit level as per Table 11. An acceptable alternative is CSA-C88, Table 3.

.5 Insulation Levels:

.1 Minimum insulation levels for winding and bushing shall be as specified on the Datasheet.

.2 Neutral bushings shall have same insulation as line bushings. All other requirements shall be as per CSA-C88, Section 11.

.6 Overload Capability:

.1 Transformers with 65°C temperature rise shall have overload capabilities in accordance with NEMA Publication TR98.

.7 Sound Level:

.1 Sound levels shall not exceed the values in CSA-C88, Table 8.

.8 Tolerances:

.1 Tolerances shall be as per CSA-C88, Table 9.

.2 Specific Characteristics:

.1 See Transformer Datasheet for Details.

.2 High Voltage Compartment:

.1 Tamper resistant HV enclosure shall be mounted on the front and enclose the HV bushings. The doors shall be secured with penta headed bolts.

.2 High voltage bushings shall be deadfront Pfisterer type suitable for Pfisterer connex separable connectors.

.3 Primary bushings shall be enclosed in a tamper resistant termination box with adequate space provided for termination of incoming 69kV, 1C-500MCM cable.

.3 Secondary Cable Compartment:

.1 Secondary bushings shall be suitable for connecting secondary cable using ANSI 386 bushing wells or one piece bushings complying with deadfront construction.

.2 The neutral bushing shall be brought out and shall be suitable for connection to the neutral grounding resistor.

.3 The phase bushings shall be located in a tamper resistant enclosure. The compartment shall provide sufficient wiring space and cable bending radius for bottom outgoing two (2) runs of 3 conductors, 500 MCM, 15kV, 133 percent insulation copper TECK90 cables per phase.

.4 Provide a 6.35 mm thick x 50.8 mm wide copper ground bus along entire width of the bottom of the compartment for ground connections.

.4 Provide a tamper resistant gauge box with hinged door and 3-point latching pad-lockable handle. The box is to be easily accessible from ground level.

.5 Neutral Grounding Resistor (NGR):

.1 See Datasheet for details.

.2 Rating: 7200 V line-neutral voltage, 100 A, duty rated for 10 seconds.

.3 Maximum permissible temperature rise of the enclosure, components (excepting resistor elements), and discharge air shall not exceed the values shown in Table 8 of CSA C22 No. 295-2015 (R2020) for “Duty Rated Assemblies”.

.4 Temperature rises for resistor materials shall not exceed the values shown in Table 9 of CSA C22 No. 295-2015 for a duty of “> 10 min” and the resistor material utilized.

.5 Temperature rises shall be based on an ambient of 40 degrees C.

.6 The NGR shall be “isolated by elevation” by mounting it on the top of the transformer enclosure.

.7 The NGR shall be insulated for the full transformer secondary line-to-line voltage.

.8 The NGR shall be labelled and marked in accordance with the requirements of CSA C22 No. 295-2015 (R2020), Section 5.

.9 NGR shall be provided with a current transformer and a sensing resistor manufactured by Littlefuse Startco and connected to the Startco SE-330 neutral ground monitor relay. Refer to the Drawings for the CT ratio and accuracy class.

.10 Connections between the transformer neutral X0 bushing and the NGR HV terminal and sensing resistor shall be by the transformer Manufacturer.

.11 Connections between the sensing resistor and external relay shall be brought to the terminal blocks in the control panel in an organized fashion to minimize the number of connections and simplify maintenance.

.12 The Startco SE-330 NGR monitor relay, test switch and terminal blocks shall be located in a separate control panel section on the transformer. Provide anti-condensate heater and thermostat in the control panel section. All power supply, input and output terminals of the SE-330 shall be wired out to the terminal blocks for external cable connections.

.13 Grounding connection between the NGR LV terminal and the substation ground grid shall be by the Contractor. The NGR shall be connected to the substation ground grid by a separate connection

.6 Transformer Accessories:

.1 See Datasheet for details.

.2 Lifting eyes and jacking pad shall be provided at appropriate location on the transformer tank.

.3 Liquid temperature thermometer (in Celsius) with a drag hand for maximum indicated temperature (resettable), alarm and tripping contacts.

.4 Liquid level indicator shall be a magnetic oil level gauge with alarm and tripping contacts.

.5 Winding temperature thermometer (in Celsius) with a drag hand for maximum indicated temperature (resettable), alarm and tripping contacts.

.6 Pressure relief device shall be sized to prevent damage to the tank in case of an internal fault. One (1) sealed tripping contact provided to trip when the pressure relief device operates. Insulating fluid discharged from pressure relief device operation shall be directed downwards towards the oil containment and away from operational area and equipment.

.7 A Rapid Pressure relay shall be installed provided to detect a rapid pressure rise in the transformer tank. The relay shall include a seal-in relay with two (2) output contacts for tripping purposes. Seal-in relay shall be located in the protection and control panel.

.8 Pressure vacuum bleeder control and indication device shall be installed on the transformer tank and located to allow readability at ground level.

.9 For liquid drain, a valve closed with a threaded plug shall be provided.

.10 For liquid sampling, a valve closed with a threaded plug shall be provided. Note that a combination liquid drain/sampling valve c/w threaded plug(s) is also acceptable.

.11 Provide top and bottom connections, closed with threaded plugs for liquid treatment connection.

.12 Lockable indicator type shut-off valves shall be provided on the top and bottom radiator connection pipes if detachable radiators are provided. Radiators shall be provided with drain and vent plugs.

.13 Grounding pads with 4-hole NEMA configuration, drilled and tapped for 13 mm bolt connection shall be provided on opposite sides of the transformer tank. The minimum threaded depth of the holes shall be 13mm.

.14 Transformer core ground connection shall be brought out of the tank to permit core insulation testing if and when required.

2.2 FINISH

.1 Transformer shall be primed and painted to ASA 70 light grey.

.2 Finish tank exterior in accordance with CSA-C88.

2.3 APPROVED MANUFACTURERS AND STANDARD OF ACCEPTANCE

.1 Approved Equipment Manufacturer:

PTI Transformer or approved equal.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Basic Electrical Materials and Methods, and as indicated on the Datasheet.

.2 Provide metallic (stainless steel) Transformer Nameplate (Rating Plate) in accordance with CSA-C88 on the outside of the transformer and on the inside of the transformer in the cable compartment.

.3 Equipment (transformer mounted devices, test switches, ratio selection terminal blocks, etc.), nameplates and tags shall be as indicated in the Specifications, Drawings and on Datasheet

.4 Nameplates and equipment tags shall be in accordance with the requirements of Section 26 05 00.

.5 Provide a lamacoid equipment identification on the outside of the transformer, example as follows:

BANK 1
12.5 MVA, 66 kV-12.47kV, 3Ø, 4W
FED FROM MB HYDRO LINE R82

.6 Provide warning nameplates on the front of the control panel which if fed by multiple sources of power. The warning lamacoids shall have white lettering on a red background. The wording shall list all AC and DC power sources including source voltage, source panel and panel circuit numbers, where control compartments are equipped with internal disconnecting fuses list fuses. Wording shall conform to the requirements of the CEC, typical example as follows:

WARNING
120VAC & 125VDC POWER PRESENT
FROM MULTIPLE SOURCES

REFER TO DRAWINGS AND ISOLATE
BEFORE WORKING WITHIN

POWER SOURCES
120VAC - PANEL XXX CCT XX

125VDC - PANEL XXX CCT XX
CONTROL PANEL 125VDC INTERNAL
DISCONNECTING FUSES
FUX-P/FU1-N
FUX-P/FU2-N

.7 Nameplates shall be attached by means of rivets, drive pins, or self-tapping screws. Note that the use of “sheet metal” or other screws having sharp points is NOT acceptable.

.8 Submit a detailed list of all proposed nameplates and equipment tags for review prior to fabrication.

2.5 SOURCE QUALITY CONTROL

.1 Submit to the Contract Administrator standard factory test certificates for each material in accordance with Specification Section 26 08 05, General Electrical Requirements - Electrical.

.2 Transformer shall be completely factory tested and the results certified, proving the performance of the units to provide capacities as listed in these Specifications.

.3 The following tests shall be performed in accordance with CSA C88:

.1 Resistance measurement of all windings.

.2 Ratio test at rated connection and on all taps.

.3 Polarity and phase relation tests.

.4 Sound level test.

.5 No-load loss at rated voltage and losses at 25%, 50%, 75% and 100% load.

.6 Excitation current at rated voltage.

.7 Impedance and load loss test.

.8 Short circuit impedance/leakage reactance.

.9 Frequency response of stray losses.

.10 Demagnetization.

.11 Dielectric frequency response.

.12 Insulating liquid lab test.

.13 Applied potential test.

.14 Induced potential test.

.15 Partial discharge test.

.16 Impulse tests: Primary & Secondary (Type Test).

.17 Pressure test.

.18 Capacitance and power factor dissipation test.

.19 Heat run, temperature rise test (Type Test).

.4 Perform a sweep frequency test (SFRA) in accordance with IEEE C57.149-2012 on all transformer terminals at the Vendor's factory prior to loading the transformer for shipment.

.1 The SFRA test shall be the last test performed immediately before loading on the transport truck/trailer and shipping and shall be performed with the transformer in its "transport" configuration.

.2 The SFRA test shall be the first test performed immediately upon receipt and unloading at the site. This test shall be performed with the transformer in its "transport" configuration and before any other testing or work is undertaken on the transformer.

.3 Record (for each separate test):

.1 Sweep frequency test waveforms and response waveforms,

.2 Complete test equipment data including; Manufacturer, model, serial number of the test equipment, and all test equipment,

.3 Provide details (photographs and detailed sketches or drawings) of the testing configurations, and connections.

.4 Include copies of the above data (both hard copy printouts and electronic files) with the transformer at shipment, forward a separate copy to the Contractor.

.4 Sweep frequency tests will be used to confirm that the transformer has not suffered damage in transport, and if necessary assist in the analysis of transport induced damage, by comparing the results of the test sets in .1 and .2 above.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with Manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Inspect the transformer on receipt for evidence of damage during shipping.

.2 Install transformers in accordance with Contract Documents and Manufacturer's installation instructions, coordinate work with other trades.

.3 Ensure concrete transformer pad has cured for a minimum of 28 days before installation of transformers.

.4 Use spreader bars on slings when lifting transformers into place.

.5 Set and secure transformer in place rigid, plumb, and square.

.6 Fasten the transformer to the pad using the fixing holes provided by the transformer Manufacturer.

.7 Assemble and “dress” the transformer as required in accordance with the Manufacturer’s instructions and requirements.

.8 Route and terminate the 66 kV power cable to the HV terminal section using the Pfisterer connectors.

.9 Route and terminate the 15 kV power cable to the LV terminal section using IEEE 386-approved elbow connectors.

.10 Ensure internal connections are mechanically tight.

.11 Process the transformer as required in accordance with the Manufacturer’s instructions. Provide all required insulating fluid processing equipment, including, but not limited to, pumps, heaters, vacuum roughing and diffusion pumps, and controls required for the proper on-site filling and vacuum degassing of a liquid filled power transformer. Insulating fluid handling hoses and equipment shall be compatible with the insulating fluid and shall be metallic and rated for full vacuum. Engage the services of a company qualified to provide the required full-vacuum leak testing, processing, and filling of the transformer.

.12 Make required external cable connections as depicted in the Drawings.

.13 Connect transformer case grounding pads, grounding bus, control panel ground bar, and any other required grounding connections to the substation ground grid in accordance with the Drawings.

.14 Set the transformer Tap Switch taps to produce rated secondary voltage at no-load.

DANGER: The Transformer Tap Switch is an "**De-energized, Off-Load Device,**" and must **not be operated** unless the transformer is fully **Isolated and De-energized**. The Transformer Tap Switch shall be **padlocked at all times** excepting when the transformer is Isolated and De-Energized for the purpose of changing taps, and shall be immediately re-locked after changing taps and prior to energization.
Tap changing operations shall only be performed by trained qualified skilled workers who are familiar with these requirements and who are working under a written and approved procedure.

3.3 FIELD QUALITY CONTROL

.1 Pre-Commissioning Tests

.1 Demonstrate, in the presence of the The City and/or the Contract Administrator, all mechanical and electrical equipment are working properly.

.2 Submit commissioning plan to the Contract Administrator for review fourteen (14 days) before the planned commissioning date.

.3 Vendor shall assist the Contractor when performing initial testing to establish the integrity of the transformer.

.4 Submit relevant equipment repair procedures to the Contract Administrator if repairable defects are identified during testing. Do not repair or use defective parts without prior approval from the Contract Administrator.

.2 Commissioning Tests

.1 Vendor shall assist the Contractor in conducting commissioning tests only after the satisfactory completion of the pre-commissioning tests, and prior to the turnover of the equipment to the The City.

.3 Start-Up and Training

.1 Provide suitable field service technician to verify all cable and wiring terminations made by others and advise The City of any errors. Start-up equipment and conduct all required tests.

.2 Vendor to provide training and demonstration to The City covering all aspects of equipment operation, maintenance, troubleshooting and controls.

.3 The Vendor shall assist the Contractor during commissioning of the transformer under his responsibility in the Scope.

.4 Onsite service technician shall be present for the following stages of construction:

.1 Field quality control.

.2 Equipment startup.

.3 All levels of commissioning.

3.4 WARRANTY

.1 The Vendor shall provide a complete warranty for all equipment, labor and materials for the high voltage pad-mount transformer valid for a period of 2 years from the date following Substantial Completion of the Winnipeg North Garage Replacement construction contract.

END OF SECTION

Row	Description	Design Requirements	Vendor Confirmation	Rev.
1	**GENERAL**			
2	TRANSFORMER EQUIPMENT NUMBERS	BANK 1		
...	QUANTITY REQUIRED	1		
	VENDOR QUOTATION NUMBER	VENDOR TO SPECIFY		
	VENDOR QUOTATION DATE	VENDOR TO SPECIFY		
	EQUIPMENT MANUFACTURER			
	RATING			
	BASE RATING (MVA)	12.5		
	COOLING	KNAN		
	RATED PRIMARY VOLTAGE (kV)	66		
	PRIMARY WINDING CONNECTION	DELTA		
	SECONDARY WINDING BIL (kV)	350		
	RATED SECONDARY VOLTAGE (kV)	12.47		
	SECONDARY WINDING CONNECTION	WYE, RESISTANCE GROUNDED		
	SECONDARY WINDING BIL (kV)	110		
	VECTOR GROUP	Dyn1		
	OPERATING ENVIRONMENT / PHILOSOPHY			
	ELEVATION ABOVE SEA LEVEL (METERS)	< 237		
	EQUIPMENT LOCATION (INDOORS / OUTDOORS)	OUTDOORS		
	UNUSUAL CONDITIONS (GASSES & DUSTS)	NOT APPLICABLE		
	HAZARDOUS AREA CLASSIFICATION	UNCLASSIFIED		
	AMBIENT DESIGN TEMPERATURE RANGE (°C)	±40		
	SEISMIC CLASSIFICATION	0		
	OPERATING SCHEDULE	CONTINUOUS WITH SCHEDULED MAINTENANCE		
	MEASUREMENT SYSTEM			
	METRIC / IMPERIAL	METRIC		
	REFERENCE SPECIFICATION			
	SPECIFICATION SECTION NUMBER	26 12 13 – LIQUID FILLED, HIGH VOLTAGE POWER TRANSFORMERS		
	APPLICABLE STANDARDS			
	SEE SPECIFICATON 26 12 13, SECTION 1.2	COMPLIANCE REQUIRED VENDOR TO CONFIRM		
	REFERENCE DRAWINGS	E-9000 E-9001 E-9002		
	UTILITY AVAILABLE FAULT LEVELS			
	IN SERVICE VALUES (CURRENT)			
	LINE R82 NORMAL OPERATION (ROSSER STN)	TBA		
	THREE PHASE (KA)	TBA		
	SINGLE LINE TO GROUND (KA)	TBA		
	YEAR HORIZON VALUES (FUTURE)			

Row	Description	Design Requirements	Vendor Confirmation	Rev.
	LINE R82 NORMAL OPERATION (ROSSER STN)	TBA		
	THREE PHASE (KA)	TBA		
	SINGLE LINE TO GROUND (KA)	TBA		
	FUTURE NORMAL OPERATION	TBA		
	THREE PHASE (KA)	TBA		
	SINGLE LINE TO GROUND (KA)	TBA		
	TAPS			
	LOCATION	PRIMARY		
	TYPE	DE-ENERGIZED, (SEE ALSO "TAP SELECTOR SWITCH" BELOW)		
	RATING	2 @ 2.5 % FCAN 2 @ 2.5 % FCBN		
	DESIGN IMPEDANCE	MIN. 7.5%		
	POS. SEQ. IMPEDANCE (%), KNAN	VENDOR TO SPECIFY		
	ZERO SEQ. IMPEDANCE (%), KNAN	VENDOR TO SPECIFY		
	X/R RATIO	VENDOR TO SPECIFY		
	SOUND LEVEL AT 100% LOAD KNAN (dB_a)	PER CSA C88		
	LOAD LOSSES @ 85°C KNAN (kW)	VENDOR TO SPECIFY		
	NO LOAD LOSSES @ 100% RATED VOLTAGE (kW)	VENDOR TO SPECIFY		
	FLUX DENSITY @ 100% RATED VOLTAGE (T)	VENDOR TO SPECIFY		
	SHORT CIRCUIT WITH STAND	(SEE UTILITY FAULT LEVEL DATA ABOVE)		
	MULTIPLE OF KNAN CURRENT	VENDOR TO SPECIFY		
	MAXIMUM FAULT DURATION	VENDOR TO SPECIFY		
	DIMENSIONS AND WEIGHTS			
	DIMENSIONS (EACH TRANSFORMER)			
	OVERALL LENGTH (mm)	VENDOR TO SPECIFY		
	OVERALL WIDTH (mm)	VENDOR TO SPECIFY		
	OVERALL HEIGHT (mm)	VENDOR TO SPECIFY		
	WEIGHTS (EACH TRANSFORMER)			
	CORE AND COILS (kg)	VENDOR TO SPECIFY		
	TANK AND FITTINGS (kg)	VENDOR TO SPECIFY		
	INSULATING LIQUID (kg)	VENDOR TO SPECIFY		
	RADIATORS (kg)	VENDOR TO SPECIFY		
	TOTAL (kg)	VENDOR TO SPECIFY		
	SHIPPING DIMENSIONS (EACH TRANSFORMER)			
	TRANSFORMER – L x W x H (mm)	VENDOR TO SPECIFY		
	RADIATORS – L x W x H (mm)	VENDOR TO SPECIFY		
	ITEMS SHIPPED LOOSE – L x W x H (mm)	VENDOR TO LIST IN DETAIL		
	SHIPPING WEIGHTS (EACH TRANSFORMER)			
	TRANSFORMER SHIPPED (FILLED WITH INSULATING FLUID/WITHOUT INSULATING FLUID)	VENDOR TO SPECIFY		

Row	Description	Design Requirements	Vendor Confirmation	Rev.
	MAIN TRANSFORMER /w INSULATING FLUID (kg)	VENDOR TO SPECIFY		
	MAIN TRANSFORMER /wo INSULATING FLUID (kg)	VENDOR TO SPECIFY		
	ITEMS SHIPPED LOOSE (kg)	VENDOR TO LIST IN DETAIL		
	TRANSFORMER CONSTRUCTION			
	LIQUID PRESERVATION	SEALED TANK		
	PROVISIONS FOR VACUUM FILLING/PROCESSING	REQUIRED (FULL VACUUM)		
	INSULATING FLUID	VEGETABLE ESTER BASED (FR3)		
	INITIAL FILL OF INSULATING FLUID	REQUIRED		
	INSULATING LIQUID VOLUME /TRANSFOMER (Liters)	VENDOR TO SPECIFY		
	METHOD OF INSULATING FLUID SHIPMENT (DRUMS, TANKER, TRANSFORMER SHIPPED PRE- FILLED)	VENDOR TO SPECIFY		
	MANUFACTURER	CARGILL		
	TYPE	ENVIROTEMP FR3		
	PRESSURE VACUUM BLEEDER	REQUIRED		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE	VENDOR TO SPECIFY		
	TRANSFORMER FILL AND DRAIN/SAMPLING VALVES	REQUIRED		
	FILL VALVE LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	EQUIPPED WITH “SAFETY” PIPE PLUG DRAIN / SAMAPLING VALVE	REQUIRED		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	EQUIPPED W ITH “SAFETY” PIPE PLUGS	REQUIRED		
	TANK GROUNDING PADS (QTY 2, ON OPPOSITE CORNERS OF TRANSFORMER)	4-HOLE NEMA STD		
	GASKET MATERIAL	VENDOR TO SPECIFY		
	EXTERIOR FINISH	EPOXY ENAMEL		
	EXTERIOR COLOUR	ASA 70, LIGHT GRAY		
	INTERIOR FINISH	EPOXY ENAMEL		
	INTERIOR COLOUR	WHITE		
	DETACHABLE RADIATORS	VENDOR TO SPECIFY		
	RADIATOR ISOLATION VALVES	REQUIRED IF RADIATORS DETACHABLE		
	TYPE	VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		

Row	Description	Design Requirements	Vendor Confirmation	Rev.
	LOCKABLE	REQUIRED		
	WINDINGS			
	PRIMARY WINDING - MATERIAL	COPPER		
	PRIMARY WINDING - TYPE	DISK		
	SECONDARY WINDING - MATERIAL	COPPER		
	SECONDARY WINDING - TYPE	DISK		
	SECONDARY WINDING - INSULATION	NON-GRADED		
	HIGH VOLTAGE PRIMARY BUSHINGS (H1, H2, H3)			
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	PFISTERER		
	STANDARD OF CONFORMANCE (ANSI, EEMAC)	ANSI/IEEE		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	VOLTAGE RATING (kV)	66 (MINIMUM)		
	CURRENT RATING (A)	VENDOR TO SPECIFY	``	
	BIL LEVEL (kV)	350 (MINIMUM)		
	CREEPAGE DISTANCE (mm)	PER CSA C88		
	NEUTRAL GROUNDING RESISTOR (NGR)			
	LOCATION	MOUNTED ON TOP OF TRANSFORMER, SEE DRAWINGS AND SPECIFICATIONS		
	MANUFACTURER	VENDOR TO SPECIFY		
	RATING, L-N (V)	7200		
	SHORT TIME CURRENT RATING	100A FOR 10 SECONDS		
	RESISTOR MATERIAL	STAINLESS STEEL		
	ENCLOSURE	NEMA 3R, VENTILATED		
	ENCLOSURE MATERIAL	STAINLESS STEEL		
	X_0 BUSHING TO NGR CABLE	15KV INSULATED RW90 CONDUCTOR, BY TRANSFORMER VENDOR		
	SENSING RESISTOR TO X_0 BUSHING CABLE	15KV INSULATED RW90 CONDUCTOR BY TRANSFORMER VENDOR		
	NGR GROUND CABLE	4/0 AWG BARE GROUNDING CABLE (DIRECT TO GROUND MAT), BY CONTRACTOR		
	NGR CURRENT TRANSFORMER			
	LOCATION	IN NGR ENCLOSURE		
	MANUFACTURER	VENDOR TO SPECIFY		
	CT RATIO	200:5A		
	CT ACCURACY	C200		
	NGR SENSING RESISTOR			
	LOCATION	IN NGR ENCLOSURE		
	STANDARD OF ACCEPTANCE (SEE NOTE 1)			

Row	Description	Design Requirements	Vendor Confirmation	Rev.
	MANUFACTURER	***LITTELFUSE STARTCO***		
	PART NO	***ER-15KV***		
	NGR RELAY			
	LOCATION	CONTROL PANEL SECTION		
	MANUFACTURER	STARTCO		
	MODEL	SE-330		
	TRANSFORMER SECONDARY COMPARTMENT			
	SECONDARY AND NEUTRAL BUSHING ENTRANCE	VENDOR TO SPECIFY		
	NEUTRAL X_0 BUSHING TO NGR AND X_0 BUSHING TO SENSING RESISTOR CONDUCTOR LOCATION	SIDE OR BACK, (TOP EXIT NOT ACCEPTABLE) VENDOR TO SPECIFY		
	X_0 BUSHING TO NGR AND X_0 BUSHING TO SENSING RESISTOR CONDUCTORS TYPE & SIZE	1c #1 AWG, 15kV, BY TRANSFORMER VENDOR, VENDOR TO SPECIFY		
	TERMINATION COMPARTMENT ACCESS PROVISIONS	CONTINUOUS HINGE, BOLTED, GASKETED DOOR(S) c/w PADLOCKABLE 3 POINT LATCHES (SPLIT DOORS PREFERRED). BOLTS TO BE TAMPERPROOF		
	INTERNAL GROUND BAR	REQUIRED, 6.35 x 50.8 mm, FULL WIDTH, TAPPED FOR WIRE LUGS, DRILLED FOR NEMA STD 2-HOLE LUG @ BOTH ENDS		
	SECONDARY BUSHINGS (X1, X2, X3)			
	LOCATION	SECONDARY COMPARTMENT		
	MANUFACTURER	VENDOR TO SPECIFY		
	STANDARD OF CONFORMANCE (ANSI, EEMAC)	ANSI/IEEE		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	VOLTAGE RATING (kV)	12.47 (MINIMUM)		
	CURRENT RATING (A)	VENDOR TO SPECIFY		
	BIL LEVEL (kV)	110 (MINIMUM)		
	CREEPAGE DISTANCE (mm)	VENDOR TO SPECIFY		
	CABLE TERMINATION REQUIREMENT	SUITABLE FOR 2 RUNS OF 3C-500MCM, 15kV HVTECK 133% TERMINATION		
	SECONDARY NEUTRAL BUSHING (X0)			
	LOCATION	SECONDARY COMPARTMENT		
	MANUFACTURER	VENDOR TO SPECIFY		
	STANDARD OF CONFORMANCE (ANSI, EEMAC)	ANSI/IEEE		
	TYPE	PORCELAIN, FULLY RATED		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	VOLTAGE RATING (kV)	12.47 (MINIMUM)		
	CURRENT RATING (A)	VENDOR TO SPECIFY		

Row	Description	Design Requirements	Vendor Confirmation	Rev.
	BIL LEVEL (kV)	110 (MINIMUM)		
	CREEP DISTANCE (mm)	PER CSA C88		
	TERMINAL PAD	4-HOLE NEMA STD		
	TRANSFORMER AUXILIARY EQUIPMENT			
	TOP INSULATING FLUID TEMPERATURE (ANSI DEVICE 71T)	**REQUIRED**		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	ALARM CONTACT (HI)	1 (N.O.)		
	ALARM SETPOINT (°C)	VENDOR TO SPECIFY		
	TRIP CONTACT (HI-HI)	1 (N.O.)		
	TRIP SETPOINT (°C)	VENDOR TO SPECIFY		
	WINDING TEMPERATURE (ANSI DEVICE 49T)	**REQUIRED**		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	ALARM CONTACT (HI)	1 (N.O.)		
	ALARM SETPOINT (°C)	VENDOR TO SPECIFY		
	TRIP CONTACT (HI-HI)	1 (N.O.)		
	TRIP SETPOINT (°C)	VENDOR TO SPECIFY		
	OIL LEVEL INDICATOR (ANSI DEVICE 71Q)	**REQUIRED**		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	ALARM CONTACT (LO)	1 (N.O.)		
	ALARM SETPOINT	VENDOR TO SPECIFY		
	TRIP CONTACT (LO-LO)	1 (N.O.)		
	TRIP SETPOINT	VENDOR TO SPECIFY		
	PRESSURE RELIEF DEVICE (ANSI DEVICE 63P)	REQUIRED		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	QUALITROL		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	OUTPUT CONTACT	1 (N.O.)		
	RAPID PRESSURE RISE RELAY (ANSI DEVICE 63Q)	REQUIRED		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	QUALITROL		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	TAP SELECTOR SWITCH	REQUIRED		

Row	Description	Design Requirements	Vendor Confirmation	Rev.
	TYPE (POSITIVE DETENT, DE-ENERGIZED OPERATION w/ TAP POSITION INDICATION)	REQUIRED		
	QUANTITY REQUIRED	1 (PER TRANSFORMER)		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	PADLOCKABLE	REQUIRED		
	WARNING PLATE INDICATING	REQUIRED, MOUNT AT TAP SWITCH OPERATING		
	" DANGER DO NOT OPERATE TAP SELECTOR SWITCH WITH TRANSFORMER ENERGIZED" OR SIMILAR APPROVED WORDING	HANDLE, BLACK LETTERING ON RED BACKGROUND, MINIMUM 12mm LETTERING		
	RAPID PRESSURE RISE SEAL-IN RELAY (ANSI DEVICE 86Q)			
	SEAL-IN RELAY EQUIPMENT TAGS	SEE DRAWINGS & SPEC.		
	LOCATION	CONTROL PANEL		
	QUANTITY REQUIRED	1 (PER TRANSFORMER)		
	MANUFACTURER	QUALITROL		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	NAMEPLATES			
	TRANSFORMER RATING PLATE IN ACCORDANCE WITH CSA-C88-M90 (R2009), CLAUSE 17 – RATING PLATE	REQUIRED		
	TRANSFORMER TAGS & NAMEPLATES	AS INDICATED ABOVE SEE SPECIFICATIONS FOR SPECIFIC REQUIREMENTS AND SIZES		
	EQUIPMENT TAGS & NAMEPLATES	EQUIPMENT TAGS AS INDICATED ABOVE SEE SPECIFICATIONS FOR SPECIFIC REQUIREMENTS AND SIZES		
	CONNECTIONS AND WIRING			
	WIRING	AS PER SPECIFICATIONS		
	COMMUNICATIONS	TBD		
	COMMUNICATIONS PROTOCOL	TBD		
	TESTING			
	TYPE TESTS	AS PER SPECIFICATIONS AND STANDARDS		
	MANUFACTURERS ROUTING TRANSFORMER TESTING	AS PER SPECIFICATIONS AND STANDARDS		
	WITNESS TESTING	AS PER SPECIFICATIONS AND STANDARDS		
	OTHER TECHNICAL REQUIREMENTS	AS SPECIFIED		
	PROVIDE COMPLIANCE STATEMENT TO SPECIFICATION REQUIREMENTS	VENDOR TO PROVIDE		
	ENGINEERING NOTES:			
	1. PROVIDE EXTRA LENGTH BUSHINGS, MOUNT MUSHINGS ON TURRETS, OR BOTH AS REQUIRED TO GIVE SPECIFIED ISOLATION DISTANCE.			

Row	Description	Design Requirements	Vendor Confirmation	Rev.

SIGNATURES: (Both signatures below are required)

Authorised Representative at Quoting Agency (Vendor)			
Name [PRINT]	Signature	Position	Date
Authorised Representative at Manufacturer's Works (Manufacturer)			
Name [PRINT]	Signature	Position	Date

1 General

1.1 SCOPE

.1 The 12.47kV switchgear have been pre-purchased by the City as part of long lead delivery items.

.2 Contractor shall install the switchgear and supply ancillary materials to complete the installation. The switchgear shall be free issue to the Contractor.

1.2 RELATED SECTIONS

.1 Section 01 33 00, Submittal Procedures

.2 Section 26 05 00, Basic Electrical Materials and Methods

.3 Section 26 12 13, Liquid filled, High Voltage Power Transformer

1.3 CODES AND STANDARDS

.1 ANSI C37.06 - Preferred Ratings and Related Required Capabilities for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

.2 ANSI C37.010 - Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

.3 ANSI C37.11 - Requirements for Electrical Controls for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

.4 ANSI C37.20.2 - Metal-Clad and Station-Type Cubicle Switchgear

.5 IEEE C37.20.7 - IEEE Guide for Testing Metal Enclosed Switchgear rated up to 38kV for Internal Arcing faults

.6 ANSI C37.23 - Metal-Enclosed Bus and Guide for calculating Losses in Isolated Phase Bus

.7 CSA No. 14 – Industrial Control Equipment

.8 ANSI C57.13 - Requirements for Instrument Transformers

.9 CAN3/CSA C13 - Instrument Transformers

.10 CSA C22.2 No. 31 - Switchgear Assemblies

.11 CAN3/CSA Z299.3 - Quality Assurance Program – Category 3

.12 CSA C22.1 - Canadian Electrical Code - part 1.

.13 ANSI/IEEE C37.100, C37.20, C37.04, C37.09 37.013A.

.14 ANSI/IEEE C37.09

.15 ANSI C37.54, C37.55, NEMA SG4.

.16 EEMAC G8.2 - Switchgear assemblies.

.17 ASTM F855 – Standard Specifications for Temporary Protective Grounds to be Used on De-energized Electric Power Lines and Equipment

1.4 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00, Submittal Procedures and Section 26 05 01, Common Work Results – Electrical. Documents shall be submitted in the quantities and formats required by Section 01 33 00, Submittal Procedures.

.2 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide proof of capabilities and experience for the programming services provider proposed for the configuration, logic development and programming of the protective relays.

.4 Shop Drawings and calculations are to be signed and sealed by a Professional Engineer, licensed in the Province of Manitoba.

.5 Shop Drawings shall include, but not be limited to:

.1 Mounting method and dimensions.

.2 Enclosure construction.

.3 Locations of shipping splits.

.4 Lifting and supporting points.

.5 Electrical single line drawings.

.6 Breaker control schematics.

.7 Breaker internal wiring schematics.

.8 Three-line diagram.

.9 Wiring Diagram.

.10 Elevation drawings.

.11 Component layout drawings.

.12 Bill of materials for all components.

.13 Door details.

.14 IR inspection window details.

.15 Communication system schematic

.16 Controls one-line diagram

.17 Conduit entry / exit locations

.18 Cable terminal sizes

.19 Field cabling requirements

.20 Equipment Electrical Ratings (Nameplates).

.21 Mimic diagram layout.

.22 System energization and startup procedures

.23 Torque specifications for all bolted current carrying connections. For connections (bus bar and cable) employing spring washers (Bellville washers) provide detailed torque calculations including Bellville washer part numbers, and material (signed and stamped).

.24 Details of the key interlock system, including part numbers, and logic diagram / table.

.25 Inspection and test plan and schedules.

1.5 OPERATIONS & MAINTENANCE (O&M) MANUAL

.1 Provide submittals in accordance to Section 01 78 00, Closeout Procedures and Section 26 05 00, General Electrical Requirements.

.2 Prepare installation, operating and maintenance (O&M) manuals in the formats and quantities required by Section 01 78 23, Operation and Maintenance Data.

.3 Each of the O&M Manuals shall include, at a minimum, the following:

.1 All Shop Drawing information.

.2 Signed and sealed equipment “As Manufactured” Drawings.

.3 Certified product test reports.

.4 Certificates of compliance.

.5 CSA certificate of inspection for the complete switchgear lineup, or Manitoba Office of the Fire Commissioner, Inspection and Technical Services Manitoba “Special Inspection” certificate for the complete switchgear lineup.

.6 Handling and installation instructions, including equipment anchorage information and provisions.

.7 Operating and maintenance instructions.

.8 Complete component list.

.9 Recommended maintenance practices and procedures.

.10 Recommended spare parts list.

.11 CT curves and data sheets.

.12 Equipment and component Manufacturer’s detailed instructions, installation and maintenance manuals.

.13 Standard cut sheets for OEM devices.

.14 Component manuals for all devices/equipment/relays incorporated into the equipment.

.15 Metering equipment settings and programming information.

.16 Site Testing & Commissioning Procedures, and recommendations and precautions for setting into operation.

.17 Test plan and inspection records.

.18 Certified copies of all test reports.

.19 Nameplate rubbings.

.20 Such additional information, instructions, data, recommendations, and procedures that the switchgear manufacturer considers to be pertinent.

.21 Relay programming and relays / controller settings (6 copies of software on 6 memory sticks) as well as printed hardcopy. Include a copy of the software needed to view / read / modify the files on each memory stick.

1.6 QUALITY ASSURANCE

.1 Accept equipment on site and inspect for shipping damage.

.2 When long term storage (> 1 week) of switchgear is required, the switchgear shall be stored indoors in a heated environment or shall be covered with a weather-proof heated hording. For short term storage (≤ 1 week) and during installation protect equipment from weather and moisture by covering with heavy plastic or canvas and by maintaining heat within the enclosure in accordance with Manufacturer's instructions.

2 Products

2.1 SCOPE

.1 Switchgear shall all be of the same type, class, and manufacture and shall utilize the same make and type of vacuum circuit breaker.

2.2 SWITCHGEAR ASSEMBLY

.1 Switchgear shall consist of outdoor skin-tight weatherproof insulated enclosure containing vacuum circuit breakers and the necessary accessory components all factory assembled (with shipping splits as required) and tested and operationally checked. The circuit breaker shall be arranged in a single high configuration. The assembly shall be self-supporting, and floor mounted on a level floor or concrete housekeeping pad. The integrated switchgear assembly shall withstand the effects of closing, carrying and interrupting currents up to the assigned short circuit rating.

.2 System Voltage: 12.47 kV, 3Ø, 3W, 60 Hz, resistance grounded.

.3 Design Voltage Class: 15 kV.

.4 Impulse Withstand (BIL): 95 kV.

.5 Power Frequency Withstand: 36 kV for 1 minute.

.6 Main Bus Current Rating: 1200 Amps, continuous, 100 percent rated.

.7 Momentary Current Rating: Equal to (or greater than) the circuit breaker close and latch rating. Switchgear structures shall be solidly grounded.

.8 Suitable for operating temperature range from -40°C to +40°C.

.9 Space heater shall be size to ensure minimum internal enclosure temperature of 5°C at an outdoor ambient of -40°C.

.10 The switchgear shall be full metal-clad construction.

.11 The depth of the finished equipment shall be sufficient to allow for entrance, bending radius, installation of high voltage power cable terminations (stress cones) and connection of power cables (for size of power cables see Drawings). Internal clearances shall comply with CSA standards.

.12 The product shall have cUL and CSA certification labels applied.

.13 The switchgear assembly shall consist of individual vertical sections housing various combinations of circuit breakers and auxiliaries, in a rigid metal-clad design. Metal side sheets shall provide grounded barriers between adjacent structures and solid removable metal barriers shall isolate the major primary sections of each circuit.

.14 Each front compartment shall be provided with a formed steel hinged door with hand operated door latches. Doors shall be provided with provisions for padlocking, and a means to permit visual confirmation of the circuit breaker position from outside the door.

.15 Interlocks shall be provided to prevent racking a circuit breaker into or out of a compartment with the circuit breaker compartment door in the open position. This interlock may be manually circumvented for maintenance purposes by a deliberate act on the part of the operator. This override shall require a minimum of two separate and distinct operations, neither of which is part of normal operations.

2.3 COMPONENTS

.1 General

.1 The switchgear shall be compartmentalized and fabricated in sections. The sections shall be divided by metal barriers into the following separate compartments:

.1 MV Circuit breaker,

.2 Instruments,

.3 Low voltage relay and control,

.4 Main bus,

.5 Auxiliary devices, and

.6 Incoming/outgoing cable(s).

.2 Each vertical section shall have one circuit breaker compartment(s) as indicated on the Drawings.

.2 Cable Compartment / Power Connections

.1 The cable compartment shall be able to accept standard customer requirements for cable terminations, including lugs, potheads and stress cones.

.2 Bus supports shall be epoxy based standoff insulators. Provision shall be made for adding cable supports as required.

.3 Cable connection pads shall be supplied with insulating boots sized to accept the cable size indicated on the Drawings. Cable connection pads shall be drilled to NEMA standard 4- hole pattern.

.4 Cable entry shall be bottom entry for all incoming and outgoing feeders.

.5 Space shall be allowed for the mounting of a zero sequence CT around the cables. Include spare terminal blocks and mounting hardware.

.6 Cable entry/exit plates shall be stainless steel. Cable compartment gland plates shall be non-magnetic and removable.

.7 Inter-cell barriers shall be stainless steel.

.8 The cable compartment door shall be hinged and bolted type and shall be key interlocked to prevent opening with the circuit breaker in the “Connected” position.

.9 Provide Infrared (IR) inspection windows on the cable compartment doors. IR windows shall be sized and located to permit thermal (IR) scanning of the cable connection area(minimum 2 windows per cable compartment door termination area).

.1 Manufacturer: IRISS (NO Equals or Substitutions Permitted),

.2 Type: Reinforced polymer IR/Visible window type c/w integral cover,

.3 Series: CAP-ENV (preferred), or VPFR (acceptable),

.4 Minimum Optic Windows Size: CAP-ENV-4 (96.8 x 96.8 mm), VPFR-75 (76 mm Ø),

.3 Ground Bus

.1 The copper ground bus shall extend through the full length of the switchgear. Ground bus supports shall be NEMA Class A-20 epoxy standoff insulators.

.2 Provide a 25mm Ø ball grounding stud c/w removable insulating cover on the ground bus within each cable compartment. The ball ground stud shall be located and oriented to permit the easy installation of grounding cable sets using hot tools. The removable insulating cover shall be designed for removal and installation using hot tools. Ball studs shall be rated 43,000 Amps for 15 cycles and 30,000 Amps for 30 cycles.

.3 The ground bus system shall be capable of carrying the rated short circuit current of any breaker in the assembly for a minimum period of two (2) seconds.

.4 Provide main ground conductor cable termination points for minimum 4/0 AWG grounding cable at opposite ends of the switchgear assembly.

.5 Ground cable attachment shall be NEMA standard spacing, 2-hole pattern, long barrel crimp type lugs.

.4 Main Bus Compartment

.1 The main and vertical bus bars shall be fully rated for 1200 amps per phase, and be fully insulated for its entire length. The bus shall be tin-plated copper and of bolted connection design.

.2 Access to this compartment shall be from the rear within the structure by removing steel barrier(s). Provide for future extension of the main bus from either end, including pre- drilling of the main bus for future extension connectors.

.3 Both the main and vertical bus bars shall be contained in their own compartment within each cell.

.4 Main bus compartment shall be further compartmentalized by means of metal barriers and track resistant, flame-retardant glass polyester through insulators between adjacent compartments.

.5 Buses and joints shall be designed such that the maximum temperature rise of any part shall not exceed 60 degrees C over an ambient temperature of 30 degrees C.

.6 Bolted bus connections shall utilize four bolts minimum and shall employ constant tension devices (Bellville washers) to ensure joint integrity. Joining bolts shall be minimum Grade 5 and shall be plated for corrosion resistance. Note cadmium plating is considered to be carcinogenic and cadmium plated bolts are not acceptable.

.7 Where Bellville spring washers are utilized washer size, thickness and the final bolting torques shall be determined in accordance with the Bellville washer manufacturer’s calculation procedures and recommendations.

.8 Bus orientation shall be A-B-C top to bottom, front to back and left to right, when viewed from the front of the equipment.

.9 Bus joints and cable terminations shall be covered with form-fitting insulating boots

.5 Doors and Panels

.1 Relays, meters, flexi-test switches, control switches, indicating lights etc., shall be mounted on the formed front-hinged panel of each low voltage compartment. Control components (selector switches, control switches, lockout relays, test switches, pilot lights, etc.) shall be as per the Specifications, and as indicated on Drawings. Protective relays shall be Schweitzer Engineering Laboratories (SEL), as indicated on the Drawings.

.2 Provide front cover mimic bus, c/w plastic symbols.

.6 Circuit Breaker Compartment.

.1 The compartment design shall allow the circuit breaker to roll in and out easily.

.2 The stationary primary disconnecting contacts shall be silver-plated for wear resistance. Through-the-door circuit breaker racking shall be provided. One window suitable for viewing the position of the circuit breaker in the cell and the position of the shutters with the circuit breaker out of the cell shall be provided.

.3 A mechanical interlock system shall be provided as follows:

.1 The circuit breaker compartment door cannot be opened once the breaker is in the “Connected” position.

.2 The circuit breaker compartment door cannot be opened while the breaker is “Closed” or “On”.

.3 The circuit breaker compartment door can be opened only with the breaker is in the “Disconnected” or “Test” position only.

.4 Entrance to the stationary primary disconnecting contacts shall be automatically covered by metal shutters when the circuit breaker is withdrawn from the connected position to the “Test” or “Disconnected” position or removed from the circuit breaker compartment.

.5 Extend a ground bus into the circuit breaker compartment to automatically ground the breaker frame with high-current spring type grounding contacts located on the breaker chassis when the circuit breaker is inserted into the compartment sufficiently far that the racking drive system can be engaged, and at all times when the breaker is in the “Test”, “Connected” positions and during racking.

.6 Guide rails for positioning the circuit breaker and all other necessary hardware shall be an integral part of the circuit breaker compartment.

.7 Blocking devices shall interlock breaker frame sizes to prevent the insertion of a breaker of a lower ampere rating or interrupting capacity into a compartment designed for a breaker of a higher rating. The blocking devices shall be permanently attached to the cell and the circuit breaker and shall be non-removable without the use of specialized tools.

.8 Where outdoor switchgear is directly mounted on a concrete pad it shall be possible to remove and install the lower circuit breaker into its compartment without use of a transport truck or lift device

.7 Medium Voltage Circuit Breakers:

.1 The circuit breakers shall be rated 12.47 kV nominal, 15 kV, 60 Hz, rated with a continuous current rating of as shown on drawings and a symmetrical interrupting rating of 25 kA.

.2 The vacuum interrupters in the circuit breaker shall be mounted in a high strength molded glass reinforced polyester insulation support/ housing.

.3 Breakers of same type and rating shall be completely interchangeable.

.4 The circuit breaker shall be operated by means of a stored energy mechanism which is normally charged by a universal motor but can also be charged by the manual handle for manual emergency closing or testing. The closing speed of the moving contacts shall be independent of both the control voltage and the operator.

.5 Circuit breakers shall be “tease proof”.

.6 Provide a full front shield on the breaker.

.7 Secondary control circuits shall be connected automatically with a self-aligning, self-engaging plug and receptacle arrangement when the circuit breaker is racked into the connected position. Provision shall also be made to permit the secondary control plug to be manually connected in test position.

.8 Breaker manual control handle shall be located on each cell door, and allow for full manual operation of each breaker as detailed elsewhere in this Specification.

.9 The racking mechanism to move the breaker between positions shall be operable with the front door closed and position indication shall be visible with door closed.

.10 Each circuit breaker shall have three, clearly-marked definite positions within its enclosure, i.e. "Connected", "Test" and "Isolated" positions.

.11 Mechanical interlocks shall be provided to:

.1 Prevent inserting or withdrawing a “closed” breaker,

.2 Prevent racking a closed-circuit breaker to or from any position,

.3 Prevent closing a circuit breaker unless it is in the "Connected" or "Test" positions within the switchgear, or is fully removed from the switchgear with the secondary control circuits connected by an extension cable.

.4 Automatically discharge the stored-energy operating mechanism springs upon removal or insertion of the breaker.

.12 A shutter system shall automatically cover the fixed line and load bus stabs, when the circuit breaker moves to a disconnected position. The shutters/shutter operating mechanism shall be pad-lockable in closed position from the front of the cell. Pad locking attachment point shall be sized to permit the installation of lock extension devices without compromising the security of the system.

.13 Provide contact wear indicator for each vacuum interrupter unit.

.14 Breakers shall have a trip operation time of ≤ 3 cycles.

.8 Circuit Breaker Controls

.1 All circuit breaker controls, spring charging mechanism, and auxiliaries shall be designed for operation at 120 VAC.

.2 The Trip circuit shall be furnished with capacitor trip unit.

.3 Visible break dead front fuse holders with current limiting fuses shall be provided for each circuit breaker cell in the switchgear. Fuse holders shall be "ganged" so that fuse holders open/close as a pair. The Circuit breaker tripping circuit shall be fed from the cell "master" fuses with separate sub-fusing from the master fuses for:

.1 The circuit breaker closing coil/charging motor circuit, and

.2 The AC protection relay circuit.

.4 120 VAC control/protection power from the 120 VAC distribution panel shall connect to the switchgear at one (1) location only for each switchgear bus section. Internal distribution of the 120 VAC power within the switchgear sections shall be the responsibility of the switchgear Manufacturer.

.5 Manual circuit breaker close/trip shall be by means of a heavy duty, rotary type "pistol grip" handle breaker control switch. The breaker control switch shall be equipped with a mechanical indicator flag which shall indicate the last operated position of the switch. Indicator flag shall colour coded green – Open and red – Close.

.6 All breaker status indicating light assemblies shall be 120 VAC, low burden, high luminosity, long life, LED lamp type with coloured caps. LED lamp and colour cap shall be colour matched. LED Lamps shall be bayonet base type and shall be replaceable by removing the colour cap. Minimum status indicator requirements (plus any additional requirements shown on the Drawings) per breaker shall be as follows:

.1 Red light to indicate breaker is closed (CB CLOSED).

.2 Green light to indicate breaker is open (CB OPEN).

.9 Breaker Auxiliary Devices:

.1 Mechanical Status indicators:

.1 Mechanical status indicator to show circuit breaker main contacts "closed" or "open".

.2 Mechanical status indicator to show stored-energy operating mechanism springs" charged" or "discharged".

.2 Non-resettable mechanical operations counter (may be electrically activated).

.3 Auxiliary contacts:

.1 In addition to those contacts required internally in the switchgear for control, interlocking and indication of the circuit breaker itself, provide a minimum of four (4) NO and four (4) NC Mechanism Operated Contacts (MOCs) wired to terminal blocks as shown on the Drawings.

.2 In addition to those contacts required internally in the switchgear for control, interlocking and indication of the circuit breaker itself, provide a minimum of four (4) NO and four (4) NC Truck Operated Contacts (TOCs) wired to terminal blocks as shown on the Drawings.

.4 Racking provisions:

.1 All breaker racking shall operate “through-the-door” with the breaker compartment door in the closed and latched position

.2 Provide one (1) manual cranking handle with each switchgear assembly for manually racking circuit breakers in and out of the cubicle. A minimum of two (2) handles in total shall be supplied.

.3 Provide one 120 VAC powered portable electrical racking device for each switchgear assembly. The Electrical racking device shall be as follows:

.1 Be provided with a 20 meter long power cord (12 AWG or larger as required) equipped with a CSA 5-15R pattern cord cap,

.2 Be provided with a permanently attached hand-held portable control pendant on a 15 meter long cable. Pendant control shall include (at a minimum), a “power on/off” maintained contact pushbutton (pull “on”, depress “off”), a “power on” LED type pilot light, a directional “rack-in/rack-out” selector switch, and a momentary “run/operate” push button,

.3 Securely attach to the breaker cell door by means of mechanical attachments or magnets and shall be positively located to prevent rotation of the device body in operation. The attachment and locating means shall not require any projections or protrusions on the cell or cell door,

.4 Shall be equipped with limit switches and a slip clutch to prevent over-torquing or damaging the circuit breaker racking mechanism, the circuit breaker itself, the switchgear breaker compartment door or internal switchgear components (“stabs” and auxiliary connector),

.5 Shall be specifically designed and manufactured for the make and model of the switchgear equipment.

.4 All auxiliary relays used for controls shall be CSA approved, with heavy duty contacts rated for operation on 120 volts AC, with visual indication of coil energization.

.10 Instrument Transformers

.1 Current Transformers:

.1 Each breaker compartment shall have provision to accommodate four (4) front- accessible mounted current transformers per phase, two CTs on the bus side and two CTs on cable side of circuit breaker. Provide current transformers as indicated on the Drawings.

.2 Where the current transformers are mounted over a fully insulated fixed “stab” bottle, the current transformer assembly shall be insulated to a minimum of 600V.

.3 Where current transformers are mounted over bus or other portions of the switchgear which are not insulated for the full voltage rating of the switchgear the current transformer assembly shall be, either insulated to a minimum of 600V and "spaced" from the live parts to provide the required insulation levels, or the current transformer assembly shall be insulated for the full voltage rating of the switchgear.

.4 Current transformer wiring shall be Type SIS, minimum # 10 AWG, 600 V, 90 degrees C (minimum) and shall terminate on grounding type CT ratio selection terminal blocks (c/w removable shorting jumper(s) and ABB type "Flexitest" blocks for devices.

.5 Current transformers shall be ANSI standard relay class and have their accuracy established in accordance with the connected burden and ANSI C57.13 but shall be at least:

.1 10C200, Thermal factor 130 percent for all phase CTs.

.2 10C50, for all zero sequence CT.

.3 10C200, for all bus bar differential CTs.

.6 Zero sequence CTs shall be Manufacturer's standard design and shall be properly rated and tested for use in medium voltage switchgear installations.

.7 Zero sequence CTs windows shall be dimensioned to allow passage of the specified cables complete with NEMA standard 2-hole pattern long barrel double crimp type lugs and high voltage cable terminations.

.8 Zero sequence CTs shall be mounted in such a manner as to permit its easy removal for installation of cables complete with high voltage terminators and cable gland connectors.

.2 Potential Transformers:

.1 The main bus potential transformers shall be rated as indicated on the Drawings.

.2 The bus PTs shall be rated to withstand 15500 volts to ground on any phase, and to provide an output on healthy secondary phase windings when phase to neutral voltage increases by 173 percent on a phase to ground fault.

.3 Potential transformers shall be of the draw-out or tilt-out type protected by current limiting fuses both on primary and secondary windings. The potential transformer draw-out or tilt-out mechanism shall be designed such that the primary and secondary

.4 transformer connections and fuses shall be automatically grounded in the withdrawn position.

.5 In general potential transformers shall be as follows:

.1 Primary: 14400V,

.2 Secondary: 120V,

.3 Frequency: 60 Hz,

.4 Ratio: 120:1,

.5 Maximum System voltage: 15.5.KV,

.6 Impulse Rating:110KV BIL

.7 Thermal Rating:

.1 1500VA at 30 degrees C ambient,

.2 1000VA at 55 degrees C ambient,

.8 Accuracy Class:

.1 0.3 WXMYZ 1.2 ZZ at 100 percent rated voltage with 120V based ANSI burden,

.2 0.3 WXMY, 1.2Z at 58 percent rated voltage with 69.3V based ANSI burden,

.9 ANSI Group 2.

.11 Control Wiring and Connections.

.1 The switchgear shall be wired with the type SIS, # 14 AWG, 600 V, 90 degrees C, except where larger size wire is required by CSA standard, or specified on Drawings.

.2 The switchgear shall be provided with terminal blocks for incoming and outgoing control connections.

.3 All wiring shall be tagged and identified on both ends of every wire using printed heat

.4 shrink sleeve type wire markers. Handwritten numbering is NOT acceptable. The wire numbering scheme shall be such that the wire numbers change only when going through a device (coil, contact, etc.). Wire numbers at both ends of the same wire shall be identical. All wires on a given terminal block position shall bear the same number, with the exception that at CT shorting type ratio selection terminal blocks, wires may have different wire numbers on opposite sides of the ratio selection CT block.

.5 All wiring originating from a compartment must be first routed to terminal block.

.6 Connections to external circuits shall be brought to modular, asymmetrical DIN rail mounted snap-on construction, pressure type terminal blocks, with marking strips. Approved terminal block types are:

.1 Weidmuller Type SAK 6N (preferred), Wieland type WK 6/U (acceptable), or approved equal in accordance with B8,

.2 Weidmuller type SAK B10C (preferred), Wieland type WKN 16DS (acceptable), or approved equal in accordance with B8.

.7 A minimum of 20 percent spare terminals shall be included (minimum 20 terminal block positions.

.8 The terminal blocks for external connections shall be located in the low voltage compartment, grouped together and easily accessible, visible and shall be positioned near the compartment's field control cable and inter-cell wiring entry/exit points.

.9 All wiring not terminated on devices shall be terminated on terminal blocks. Not more than two (2) wires shall be connected to any device terminal or at any one terminal side. Interconnecting jumpers between terminal block positions shall be counted in the above 2 wire per side limitation. General and control wiring shall utilize self retaining compression type spade lugs where wiring is terminated on hardware (relays, meters, switches, etc).

.10 Spare conductors in cables shall NOT be terminated to terminal blocks, but shall be neatly trimmed, identified, taped, and left in the bottom of the compartment. Spare cable conductors shall be of sufficient length to reach the most remote terminal block position or equipment terminal within in the compartment.

.11 Current transformer secondary circuits shall utilize insulated barrel ring type compression terminals.

.12 Control circuit wiring for circuit breaker "trip" circuit shall incorporate steering/blocking diodes to ensure proper routing and isolation of trip signals from the protection relays, and operator control devices.

.13 Steering/Blocking diodes shall be NTE Electronics type 5817HC axial lead plastic encapsulated silicon rectifier, or approved equal in accordance with B8. Blocking /Steering diode characteristics shall be as follows (TA = +25 degrees C unless otherwise specified):

.1 Maximum Recurrent Peak Reverse Voltage = 1000V,

.2 Maximum RMS Voltage = 700V,

.3 Maximum DC Blocking Voltage = 1000V,

.4 Average Forward Current (TA = +50 degrees C), IF(AV) = 10A,

.5 Peak Forward Surge Current (8.3ms, Half Sine), IFSM = 400A,

.6 Maximum Inst. Forward Voltage (IFM = 10A, TA = +25 degrees C), VF = 1.0V,

.7 Maximum DC Reverse Current at Rated DC Blocking Voltage, IR (TA = +25 degrees C) = 10µA, (TA = +100 degrees C) = 100µA,

.8 Typical Junction Capacitance (Measured at 1.0MHz, VR = 4V), CJ = 150pF,

.9 Operating Junction Temperature Range, TJ = -55 degrees to +125 degrees C,

.10 Storage Temperature Range, Tstg = -55 degrees to +150 degrees C,

.11 Typical Thermal Resistance, Junction- to-Ambient, RthJA = 10K/W.

.14 Where wiring between cells crosses shipping splits the Manufacturer shall supply keyed separable plug and socket type in-line insulated connector(s) to permit separating the cells at the shipping splits without having to un-terminate wiring. The connector shall be sized to accommodate the wire gauge and current carrying capacity of the inter-cell conductors, shall be of a locking design to prevent separation in service due to vibration or other causes and shall be securely screwed or clamped to the structure(s).

.15 Where wiring crosses between structure sections (i.e. inter-cell connections), or where wiring (control cables) exits the switchgear to connect to other equipment it shall be landed on terminal blocks at both ends. Devices external to the cell (contacts, coils, etc.) shall not be "loop" connected but shall be wired back to terminal blocks in the switchgear cell on an individual basis.

.16 Soldered connections and splices in wiring are not permitted.

.12 120 VAC Inter-Cell Power Distribution Wiring and Connections

.1 The 120 VAC inter-cell power distribution wiring shall be type SIS, 600 V, 90 degrees C, and shall be sized to permit simultaneous operation of all circuit breaker spring charging motors as well as all protective relaying and controls without undue voltage drop.

.2 The switchgear shall be provided with terminal blocks in each cell for inter-cell power distribution wiring. The incoming 120 VAC terminal blocks for each switchgear assembly

.3 The 120 VAC inter-cell power distribution wiring shall be tagged and identified on both ends of every wire using printed heat shrink sleeve type wire markers. Hand written numbering is NOT acceptable. The wire at both ends of the same wire shall be identical. All wires on a given terminal block position shall bear the same number.

.13 Protective Relays

.1 Provide protection relays as indicated on Drawings for each circuit breaker. Protection relays shall be manufactured by Schweitzer Engineering Laboratories (SEL).

.2 Protection Relays shall be as follows:

Relay ID	SEL Type No.	Sel Ordering No.	Configuration Key No.	Comments
RLY-E710	SEL-751A Feeder Breaker	TBD	TBD	TBD
RLY-E710-1 RLY-E710-2	SEL-751A Feeder Breaker	TBD	TBD	TBD

.1 All relays shall be capable of being programmed using SEL "acSELerator QuickSet" Software".

.2 Include software and programming costs in the Bid Amount. It is recommended that the services of the protection relay manufacturer's Engineering Services Department be used to provide configuration, logic development and programming services.

.1 The personnel engaged to perform the protection relay configuration and programming (Programming Services Provider) shall have demonstrable experience in programming of the protection relays utilized for switchgear protection (minimum of 5 years and 3 equivalent projects),

.2 The choice of Programming Services Provider shall be subject to review and approval by the Contract Administrator.

.3 Breaker coordination settings curves in the form of "Settings Letters" will be supplied to the Switchgear Vendor and are incorporated into the Contract documents. All other settings are to be determined by the Switchgear Vendor.

.14 Ethernet Switches

.1 Provide one (1) Schweitzer Engineering Laboratories (SEL) type SEL-2730U

.2 Unmanaged Ethernet Switches c/w SEL-9330-A power supply unit as indicated on the Drawings.

Relay ID	SEL Type No.	Sel Ordering No.	Configuration Key No.	Comments
RLY-E710	TBD	TBD	TBD	TBD

.3 Wire and connect the switch in accordance with Drawing.

2.4 METERING:

.1 With each main circuit breaker provide a PowerLogic PM8000 manufactured by Schneider Electric. This item is a City of Winnipeg standard requirement, no substitutions or equals will be accepted.

.2 The Meter shall have the following characteristics: 20

.1 Current and voltage inputs.

.2 Modbus TCP communication (over Ethernet).

.3 Data logging options.

.4 I/O (Analog Inputs, Analog outputs, Digital Inputs, Digital Outputs)

.5 Alarm setpoints.

.6 Harmonics analysis

.3 Where specific metering equipment is not provided at a specific breaker, program each SEL relay to display load information on the relay display, including but not limited to Amps, Voltage, VA, VAR, etc.

2.5 FABRICATION

.1 Construction:

.1 Metal-clad switchgear shall be in weather-proof insulated enclosure suitable for temperature range of -40°C to +40°C.

.2 Each equipment bay or cell shall be a separately constructed cubicle assembled to form a rigid freestanding unit. Adjacent bays shall be securely bolted together to form an integrated rigid structure.

.3 The rear doors shall be hinged and bolted closed and shall be mechanically interlocked to prevent opening when the circuit breaker is in the “connected” position.

.4 Breaker compartment front doors shall be equipped with a lockable handle operated multi-point latching system and shall be mechanically interlocked to prevent opening when the circuit breaker is in the “Connected” position. The mechanical interlock shall be equipped with an over-ride provision which requires removal of a bolt or bolts and the use of tools to operate the over-ride.

.5 Breaker compartment doors shall be designed and equipped for breaker racking with the door closed and latched and shall equipped as required to accommodate the powered portable electrical racking device specified above.

.6 Each individual unit shall be braced to prevent distortion.

.7 Sheet steel used shall be minimum 11 gauge.

.2 Dimensions:

.1 Switchgear dimensions shall be as indicated on Drawing (Insert Drawing Number). Any proposed alternate dimensions shall be submitted to the Contract Administrator for consideration and approval in accordance with B8. Any concrete / structural impacts due to dimensional deviations from those shown on the Drawings shall be performed at no additional cost to the Contract.

.2 The metal-clad switchgear shall be fully assembled, inspected, and tested at the factory prior to shipment. Large line-ups shall incorporate shipping splits split to permit normal shipping and handling as well as for ease of rejoining at the jobs site

2.6 FACTORY FINISHING

.1 Where on site finishing is required, prepare and prime surfaces as specified in Section 09 90 00, Painting and Coating.

2.7 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - General Electrical Requirements

.2 Lamcoid for each switchgear to be size 11, example as follows:

SGR–E710 NORMAL POWER 12.47 kV, 3Ø, 3W, 1200A

.3 Lamacoid for each switchgear breaker to be size 5, example as follows:

BREAKER CB-F1 NORMAL POWER 12.47 kV, 3Ø, 3W, 600A

.4 A switchgear identification nameplate for each of the switchgear line ups indicating as a minimum:

.1 Switchgear rated voltage, rated BIL, bus ampere rating.

.2 Switchgear fault interrupting ratings, momentary fault withstand ratings, MVA Class.

.3 Switchgear power frequency AC withstand voltage, Switchgear DC withstand voltage.

.4 Switchgear maximum design temperature rise.

.5 Manufacturer's shop reference and drawing number, contact details.

.6 CSA approval, CSA design standard.

.7 Enclosure NEMA rating.

.8 Switchgear assembly weight.

.5 A lamacoid simplified mimic diagram shall be provided on the front of the switchgear.

.6 A high voltage warning nameplates for the switchgear assemblies on both front and back of the switchgear.

.7 Provide warning nameplates on the front of each control compartment containing multiple sources of power. The warning lamacoids shall have white lettering on a red background. The wording shall list all AC and DC power sources including source voltage, source panel and panel circuit numbers, where control compartments are equipped with internal disconnecting fuses list fuses. Wording shall conform to the requirements of the CEC, typical example as follows:

WARNING 120VAC POWER PRESENT FROM MULTIPLE SOURCES REFER TO DRAWINGS AND ISOLATE

BEFORE WORKING WITHIN

POWER SOURCES
120VAC PANEL XXXX CCT XX
DISCONNECTING FUSES
FU1-X/FU1-X
FU2-X/FU2-X

.8 Nameplates shall be attached by means of rivets, drive pins or self-tapping screws. Note that the use of "sheet metal" or other screws having sharp points is NOT acceptable.

.9 Submit a detailed listing of proposed equipment nameplates for review prior to fabrication and installation.

2.8 ADDITIONAL MATERIAL/ACCESSORIES

.1 Provide one (1) full box of spare control fuses for each size and rating of fuse installed.

.2 Provide one (1) spare vacuum circuit breaker of each frame size.

.3 Provide two (2) spare current and voltage transformers of each size.

.4 Provide four (4) spare pilot lights of each type and rating.

.5 Provide two (2) spare breaker open / close switches.

.6 Provide two (2) handles for manually charging the circuit breaker operating mechanisms.

.7 Provide two (2) hand cranking levers for manual racking of circuit breakers. Handles shall be suitable for "through the door" racking

.8 Provide two (2) sets of test plug assemblies for use with flexitest blocks.

.9 Provide one (1) electrically operated portable racking device complete with a wired hand-held remote control as specified above.

.10 Provide two (2) sets of circuit breaker extension rails per switchgear assembly.

.11 Provide one (1) lifting device for removal of potential transformer drawer units.

.12 Provide one (1) breaker auxiliary connector extension cable to permit electrical test operation of the circuit breaker while withdrawn from its cubicle.

.13 Provide one (1) complete set of tools for mechanical adjustments to the switchgear.

.14 Provide one (1) factory assembled “ball-stud” grounding set for each switchgear assembly (minimum 3 sets total) as follows:

.1 ASTM Type 1, Class A, Grade 3 in accordance with ASTM F855, Standard Specifications for Temporary Protective Grounds to be Used on De-energized Electric Power Lines and Equipment,

.2 Fault current ratings: 27,000 amps for 15 cycles, 20,000 amps for 30 cycles,

.3 Suitable for installation with “hot tools” (i.e. “shotgun” type hotstick),

.4 Consisting of:

.1 One (1) three-way copper terminal block,

.2 Four (4) bronze ground clamps suitable for use with 25mm Ø ball-studs,

.3 Four 1828mm lengths of # 2/0 AWG super flex copper clear jacketed ground cable with shrouded threaded-stud ferrules,

.4 All of the above shall be factory assembled and tested.

2.9 APPROVED MANUFACTURER

.1 Eaton, Schneider, ABB, GE or approved equal

2.10 FACTORY TESTING

.1 Provide certified factory test reports for all components.

.2 QA Requirements

.1 Submit an Inspection and Test Plan in accordance with this Specification, and NETA Acceptance Testing. This shall be submitted along with, or after acceptance of the Shop Drawings.

.3 Shop Inspection And Testing

.1 Equipment will be subject to inspection at the following stages of manufacture:

.1 Prior to shop testing,

.2 Prior to packaging for shipment.

.2 Test equipment to ensure satisfactory operation prior to shipping. Provide Certification of Satisfactory performance.

.3 Test and inspect all equipment, materials, works in accordance with scope of work,

.4 Specifications, all applicable codes, standards, regulations, laws and provide Certification and Records.

.5 Provide the Contract Administrator with proper access to work, equipment, tools and facilities for carrying out such inspection, test, witness inspection or test points, surveillance or audit, whether it is in preparation or progress.

.1 Provide upon request, the following information:

.1 Non-destructive test records/results,

.2 Welding procedures and welder qualifications,

.4 Factory Tests

.1 Test the equipment per applicable standards and provide test data.

.2 The Contract Administrator reserves the right to witness any or all tests.

.3 Prior to proceeding with the tests, provide in writing, a list of the tests to be performed at least two weeks before the tests are scheduled to begin, and an approximate schedule, with dates anticipated for the tests.

.4 The equipment shall be tested at the manufacturing plant prior to shipment and in accordance with the latest applicable standards.

.5 Design Tests

.1 For the design tests, include the following:

.1 Dielectric tests,

.2 Power frequency voltage withstand on main contacts,

.3 Power frequency voltage withstand on auxiliary equipment and control circuits,

.4 Partial discharge,

.5 Radio interference,

.6 Temperature rise,

.7 Measurements of the main contact's resistance,

.8 Short-time and peak withstand current,

.9 Current interrupting tests

.2 The tests classified by the standards as optional may be carried out or waived at Contract Administrator’s discretion, e.g., tests for radio interference, operational tests in extreme atmospheric conditions, etc.

.3 Perform the design tests in the Manufacturer’s plant or elsewhere by an internationally recognized laboratory, carried out on one complete circuit breaker.

.4 Where design type test results have been previously obtained and have been certified by an internationally recognized testing laboratory, they may be acceptable in lieu of the above specified type tests.

.5 In the case of the circuit breaker, ensure these tests have been carried out on 2 circuit breakers of the same type, capacity and characteristics as specified herein.

.6 Routine Tests

.1 Manufacturer's routine tests shall include all tests required by the Standards for Manufactured Switchgear. Routine factory tests shall include but not be limited to the following for all of the equipment supplied:

.1 High potential tests on main circuit contacts and control wiring,

.2 Operational tests on circuit breakers, and control devices; control wiring shall be energized and electrically operated devices shall be electrically operated at normal and minimum control voltage,

.3 Remote control systems shall be tested to demonstrate proper operation under simulated conditions,

.4 Operation of key, electrical and mechanical interlock systems shall be tested. Including verification of circuit breaker racking and positional safety interlocks,

.5 Power frequency voltage dry test and partial discharge measurements,

.6 Resistance measurement of circuit breaker and switch main contacts (Ductor Tests),

.7 Mechanical testing of switching devices,

.8 Primary current injection testing to confirm CT ratios,

.9 Corona inception and extinction tests,

.10 Provide factory test certificates for tests performed on individual switchgear components and on complete switchgear assembly.

3 Execution

3.1 EXAMINATION

.1 Visually inspect switchgear for evidence of damage and verify that surfaces are ready to receive work.

.2 Visually inspect to confirm that all items and accessories are in accordance with the Specifications and Drawings.

.3 Verify field measurements (i.e. voltage, current) are as indicated.

3.2 INSTALLATION

.1 Install in accordance with Manufacturer's instructions, applicable requirements of the CEC and in accordance with recognized industry practices.

.2 Ensure concrete pad has cured for a minimum of 28 days before installation of switchgear.

.3 Set and secure switchgear in place rigid, plumb, and square.

.4 Fasten the switchgear to the pad using the fixing holes provided by the Manufacturer.

.5 Ensure internal connections are mechanically tight.

.6 Make required external cable connections as depicted in the Drawings.

.7 Bending of high-voltage cables should be avoided or minimized. All necessary bends should meet at least the minimum radii specified by the cable Manufacturer, or by code (whichever is greater).

.8 Connect switchgear grounding bus and any other required grounding connections to the perimeter ground grid in accordance with the Drawings.

.9 Demonstrate that the system works as intended, and in accordance with the protection relay Setting Letters provided by the Contract Administrator.

3.3 FIELD QUALITY CONTROL

.1 Site Acceptance Testing

.1 Submit site acceptance testing plan to the Contract Administrator for review fourteen (14) days prior to the planned testing date.

.2 Demonstrate, in the presence of the City and/or the Contract Administrator, all mechanical and electrical equipment are working properly.

.3 Vendor shall assist the Contractor when performing initial testing to establish the integrity of the switchgear.

.2 Commissioning Tests

.1 Vendor shall assist the Contractor in conducting commissioning tests only after the satisfactory completion of the site acceptance tests, and prior to the turnover of the equipment to the The City.

.3 Touch-up paint all chips and scratches with Manufacturer-supplied paint and leave remaining paint with Contract Administrator.

3.4 TRAINING

.1 Furnish the services of a competent, factory-trained engineer or technician for two sessions (each of a minimum of 8 hours duration) instruct City of Winnipeg electrical maintenance personnel in the operation and maintenance of the equipment, on a date requested by the Contract Administrator. This item shall be specifically confirmed by the Supplier at the time of Bidding.

.1 The contents of the training session to include:

.2 Electrical manual breaker operation.

.3 Breaker rack-out procedures

.4 Operation of the portable electrically operated racking device

.5 Kirk Key interlock system

.6 Power meter use

.7 Protective relay operation, diagnostic and waveform access

.8 Network communications.

.9 Troubleshooting and maintenance, and similar contents to the training session identified above.

.10 And operation of any other relevant systems associated with the switchgear.

3.5 FINAL ACCEPTANCE

.1 If required by final field testing/commissioning results make adjustments/or changes such that an efficient and fully operational installation is achieved. Such adjustments or requirements shall be to the suppliers account. Final acceptance by the Contract Administrator will be conditional upon fulfillment of all requirements.

.2 For equipment subject to inspection by a government ministry, department, or agency, submit original copies of the test data reports and all other documentation required for the final field inspection of the equipment by the government ministry, department or agency.

.3 Following completion of the work, issue a history docket comprised of the quality certificates, inspection and test records, and any other relevant documents related to manufacture and testing for the Contract Administrator's record files.

3.6 WARRANTY

.1 The Vendor shall provide a complete warranty for all equipment, labor and materials for the 12.47kV switchgear valid for a period of 2 years from the date following Substantial Completion of the Winnipeg North Garage Replacement construction contract.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

1.2 LOCAL ELECTRICAL UTILITY REQUIREMENTS

.1 Comply with latest conditions of supply requirements of local governing electrical utility. Confirm exact requirements with local governing electrical utility and coordinate utility requirements with respective Divisions of Work providing such work. Provisions to accommodate local governing electrical utility requirements generally include but are not limited to following:

.1 preconstruction meeting;

.2 inspection: on site access for local governing electrical utility inspector to be on duty for duration of work;

.3 underground inspection: submission of approval drawings and application for inspection prior to any inspection of work;

.4 approval of work and materials by local governing electrical utility inspector prior to any backfilling work.

.2 In case of discrepancies or conflicts between Drawings and Specifications and local governing authority standards, contact Contract Administrator and obtain direction. If direction is not available prior to close of Bids, include for most costly arrangement, but ensure that direction is obtained prior to start of Work.

1.3 INCOMING ELECTRIC SERVICE WORK

.1 to the City will pay the local Utility directly to cover costs for local governing electrical utility to extend their electrical system to service property. Local governing electrical utility work to include but not be limited to provision of following:

.1 primary conductors and secondary conductors installed on poles and/or ductbank;

.2 required primary and secondary connections to substation transformer;

.3 testing of primary conductors, and connections;

.4 required off site work to incoming system;

.5 revenue metering.

1.4 SERIES RATED COMBINATIONS

.1 Series rated combinations of over-current protective devices are not permitted.

.2 Comply with local governing electrical code rule with regards to series rated combinations of over-current protective devices and ensure that equipment in which lower rated devices are installed are marked with a series combination interrupting rating at least equal to available fault current.

1.5 PROTECTIVE COORDINATION AND EQUIPMENT WITHSTAND RATINGS

.1 Obtain results of coordination study and short circuit calculations reports and Contract Administrator comments and incorporate into shop drawings of electrical distribution equipment (high voltage and low voltage equipment as applicable). Do not order equipment until shop drawings submission process has been completed and reviewed with Contract Administrator.

.2 Provide ratings for electrical equipment, circuit protective devices, bussing, and switches to interrupt and withstand short circuit faults greater than available fault current at its source of supply.

1.6 BREAKERS

.1 Breakers to be NEMA rated types, and for switchboards and distribution panelboards, breakers when frame sized greater than 225 amperes, or where scheduled or where noted on drawings, to be provided with solid state adjustable trip units with long time, short time and instantaneous time (LSI) functions and time delays. Set trip units at ratings as per coordination study as required for proper selective coordination. Unless otherwise noted on drawings, provide ground fault alarm and trip functions at breaker trip unit rating above 600 A, and set as coordinated with results of coordination study and as reviewed with Contract Administrator.

.2 Size breakers as per drawings and/or schedules, but in absence of direction, size breakers to suit intended application, to suit coordination study requirements and in accordance with local governing electrical code.

2 Products

2.1 SPLITTER TROUGH

.1 CSA approved, splitter trough each complete with:

.1 formed, factory primed and painted steel box with knockouts;

.2 hinged front coverplate;

.3 suitable mounting provisions;

.4 a nameplate giving its rating.

.2 Terminal blocks consist of pressure type main lugs and branch lugs approved for copper wiring and mounted on porcelain bases.

.3 Enclosures for splitters mounted in climate controlled areas to be NEMA 1. For standard non-climate controlled applications, enclosures to be minimum NEMA 3R. Use NEMA 4X for corrosive environment applications.

.4 Splitter trough ratings are scheduled on drawings.

.5 Acceptable manufacturers are:

.1 Bel Inc.;

.2 Hydel;

.3 Hammond.

2.2 CONTACTORS

.1 Eaton, CSA approved, NEMA rated, factory assembled, magnetic, full voltage contactors as follows:

.1 To CSA C22.2 No.14;

.2 "Freedom" CN15 series, non-reversing type for heating and motor loads; features long life twin break, silver cadmium oxide contacts and steel mounting plate; magnetically actuated switch to include remote operation capability;

.3 Series A202 electrically held, magnetically latched contactor for lighting loads; contactors designed to withstand large initial inrush currents.

.2 Each contactor to be suitable in respects for application and complete with following, as applicable:

.1 "Hand-Off-Auto" switch and pilot lamp;

.2 “START/STOP” pushbutton;

.3 an enclosure of NEMA size to suit application with necessary accessories;

.4 factory primed and painted enclosures;

.5 minimum NEMA 1 type enclosures for climate-controlled areas;

.6 minimum NEMA 3R type enclosures for non-climate-controlled areas;

.7 ampere rating, number of poles, etc., as noted on drawings.

.3 Acceptable manufacturers are:

.1 Eaton;

.2 Schneider Electric (Square D);

.3 Rockwell Automation (Allen-Bradley);

.4 Siemens.

2.3 DISCONNECT SWITCHES

.1 Heavy duty, CSA approved, disconnect (safety) switches. Features include:

.1 front operated with handle suitable for padlocking in "OFF" position and arranged so that enclosure cover cannot be opened while handle is in "ON" position;

.2 operating mechanisms: quick-break, positive acting with visible blades and line terminal shield;

.3 100% load break / make rated;

.4 non-fusible units;

.5 fusible units with fuse clips suitable for HRC fuses, unless otherwise noted;

.6 ampere rating, number of poles and fuse requirements as indicated on drawings;

.7 factory primed and painted switch enclosures.

.2 Disconnects for variable speed drives to be suitable for use with such drives and include auxiliary switch/contact to de-energize control power circuit, as required and as applicable.

.3 Enclosures for disconnects mounted in interior climate-controlled areas and standard non-climate controlled areas to be NEMA 3R. For corrosive environmental applications, enclosures to be minimum NEMA 4X.

.4 Acceptable manufacturers are:

.1 Eaton;

.2 Siemens Electric Ltd.;

.3 Schneider Electric (Square D).

2.4 FUSES

.1 Unless otherwise indicated, fuses to be Form I, Class "J" HRC fuses for constantly running equipment, and Form II, Class "C" HRC fuses for motorized equipment that cycle "ON" and "OFF".

.2 Unless otherwise indicated, fuses for use in motor control centres and motor starters to be equivalent to Mersen Class "J" type "AJT", dual element time delay type and in accordance with UL standards 248-8 and 198L.

.3 Fuses to be of type suitable for applications as required by local governing electrical codes and in coordination with respective equipment manufacturer’s recommendations in which fuses are required. Coordinate also with Mechanical Division Contractor for requirements for Mechanical Division equipment.

.4 Fuses to be of product of one manufacturer.

.5 Acceptable manufacturers are:

.1 Mersen (Ferraz Shawmut);

.2 English Electric Ltd.;

.3 Noram;

.4 Cooper Bussmann.

2.5 FUSE CABINET

.1 Fuse storage cabinet, surface wall mounted, manufactured from aluminum, approximately 750 mm (30") high, 600 mm (24") wide, 300 mm (12") deep, with provisions for supporting fuses and hinged lockable front access door. Cabinet to be finished in grey enamel paint and include identification labelling.

2.6 KEY INTERLOCKS

.1 Kirk Key Interlock Co., SD series, trapped key interlocks with features as follows:

.1 for use in climate-controlled areas;

.2 of type to suit application and physically fit equipment, as confirmed with manufacturer of equipment being interlocked and as reviewed with Contract Administrator;

.3 comprised of brass interlock housing and 303 stainless steel lock bolts;

.4 7- pin nickel - silver key with brass 7 -pin tumbler lock cylinder;

.5 keys duplicated only by manufacturer and include “DO NOT DUPLICATE” stamped on keys;

.6 key interchange code of characters stamped on keys and cylinder, as reviewed with Contract Administrator; initially assume “W” code until final review with Contract Administrator;

.7 cylinder combination number stamped on keys and cylinder;

.8 key way designation stamped on keys;

.9 nameplate;

.10 identification tag warning of required sequence of operation;

.11 complete with required accessories and mounting hardware to suit specific applications.

.2 Determine required locking bolt length, number of interlocks and cylinders, key removable option, mounting hardware and sequence of operation, to suit specific applications. Refer to drawings for additional requirements.

.3 Install devices in accordance with manufacturers instructions to suit specific applications and sequence of operations. Coordinate installation with manufacturer of equipment in with interlocks are installed provide required type for mounting and provide required hardware.

.4 Review required stamped coding for cylinders and keys, and required sequence of operations with Contract Administrator, prior to ordering.

.5 Provide identification warning tag with nomenclature reviewed with Contract Administrator.

3 Execution

3.1 INCOMING ELECTRIC SERVICE WORK

.1 As confirmed with local governing electrical utility, include for but not be limited to provision of following:

.1 provision of primary and secondary concrete encased ductbank;

.2 provision of manholes;

.3 provision of foundation padmount and grounding provisions for local electrical utility main power transformer;

.4 provision of protection bollards around pad mount transformer;

.5 provision of secondary conductors installed in concrete encased ductbank;

.6 coordination with local electrical utility for their secondary connections to main power transformer;

.7 testing of secondary conductors;

.8 coordination with local electrical utility for their low voltage metering components.

.2 Review incoming cables and duct/conduit runs from utility source and comply with local governing utility requirements for installation of cables and duct/conduit runs to The City service entrance equipment. Obtain required local governing utility details, inspections and approvals.

3.2 INSTALLATION OF SPLITTER TROUGH

.1 Provide splitter trough and install into locations and connect complete. Install with adequate clearance as per code requirements and as required for access for operation and maintenance.

.2 Ensure enclosure ratings are suitable for intended applications.

.3 Secure splitter trough in place independent of connecting conduit, secure into position and connect complete.

.4 Provide engraved lamacoid nameplate with nomenclature reviewed with Contract Administrator.

3.3 INSTALLATION OF CONTACTORS

.1 Provide contactors in enclosures for electric heating, outside lighting control and other equipment. Connect complete to equipment and auxiliary control devices as required.

.2 Wall mount each enclosure independent to panelboard to which loads are connected.

.3 Ensure enclosure ratings are suitable for intended applications.

.4 Provide engraved lamacoid nameplate with nomenclature reviewed with Contract Administrator.

3.4 INSTALLATION OF DISCONNECT SWITCHES

.1 Provide disconnects switches and install into locations and connect complete. Ensure adequate clearance is provided as per local code requirements and as required for access for operation and maintenance. Install as follows:

.1 wherever shown on drawings and/or specified herein;

.2 wherever required by MCC/VFD/starter schedule drawings;

.3 for motorized equipment which cannot be seen from motor starter location or is more than 9 m (30') from starter location (in accordance with local governing electrical code requirements);

.4 for "packaged" equipment fed from a motor starter panel.

.2 Where double throw switches are required, connect to provide operations as noted.

.3 Ensure enclosure ratings are suitable for intended applications.

.4 Provide engraved lamacoid nameplate with nomenclature reviewed with Contract Administrator.

3.5 INSTALLATION OF FUSES

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically matched mounting devices.

.3 Ensure correct fuses fitted to assigned electrical circuit.

.4 Provide a complete set of fuses for each fusible disconnect, motor starter, and similar fusible equipment provided or supplied.

.5 Supply 3 spare fuses of each size and type used on project, mount fuses in cabinet. Secure cabinet in wall location as reviewed with Contract Administrator.

3.6 PROVISIONS FOR BUILDING AUTOMATION SYSTEM

.1 Display points of electrical distribution system on building automation system as noted below.

.2 Mechanical Divisions Contractor is responsible for wiring and connections up to load side of a terminal cabinet which is provided as part of work of Electrical Divisions. Provide line side connections and ensure that no unauthorized contact is made with live current carrying parts of equipment.

.3 Typically, provide points as per following sample schedule and amend to suit exact equipment provided on site. Ensure that associated contact points such as relay contacts or voltages are made available.

ITEM #	LOCATION	FUNCTION	SIGNAL	TERMINAL CAB. #
1	Main Transformer #1	Alarm	Contact closure	1
2	Main Transformer #2	Alarm	Contact closure	1
3	600V Switchboard Normal	Main Breaker Status	"a" contact on main breaker "A"	1
4	600 V Switchboard Normal	Main Breaker Status	"a" contact on main breaker "B"	1
5	600 V Switchboard Normal	Loss of Voltage	Bus "A" analogue signal	1

ITEM #	LOCATION	FUNCTION	SIGNAL	TERMINAL CAB. #
6	600 V Switchboard Normal	Loss of Voltage	Bus "B" analogue signal	1
7	600 V Switchboard Normal	Ground Fault Bus "A"	Contact on GF equipment "A"	1
8	600 V Switchboard Normal	Ground Fault Bus "B"	Contact on GF equipment "B"	1
9	600V Switchboard Emergency	Main Breaker Status	"a" contact on main breaker "A"	1
10	600 V Switchboard Emergency	Main Breaker Status	"a" contact on main breaker "B"	1
11	600 V Switchboard Emergency	Loss of Voltage	Bus "A" analogue signal	1
12	600 V Switchboard Emergency	Loss of Voltage	Bus "B" analogue signal	1
13	600 V Switchboard Emergency	Ground Fault Bus "A"	Contact on GF equipment "A"	1
14	600 V Switchboard Emergency	Ground Fault Bus "B"	Contact on GF equipment "B"	1
15	600 V Switchboard Emergency	Loss of Voltage	Bus analogue signal	1
16	600 V Switchboard Emergency	Ground Fault Bus	Contact on GF equipment	1
17	600V Switchboard Emergency	Feeder Breaker #1 Status	"a" contact on feeder breaker "1"	1
18	600 V Switchboard Emergency	Feeder Breaker #2 Status	"a" contact on feeder breaker "2"	1
19	ATS	Emergency Feed Position	Aux. contact closure	1
20	ATS	Emergency Feed Position	Aux. contact closure	1
21	ATS	Emergency Feed Position	Aux. contact closure	1
22	ATS	Emergency Feed Position	Aux. contact closure	1
23	Generator	Ground Fault	GF equipment contact	2
24	Gen. Control panel	Low oil pressure	Contact closure	2
25	Gen. Control panel	High temperature	Contact closure	2
26	Gen. Control panel	Shut down	Contact closure	2
27	Gen. Control panel	Main breaker open	"b" contact closure	2

ITEM #	LOCATION	FUNCTION	SIGNAL	TERMINAL CAB. #
28	Gen. Control panel	Bus voltage	Analogue signal	2
29	Spare		Contact closure	1
30	Spare		Contact closure	2

.4 For potential indications, provide a fused disconnect and potential transformer, rated 600/120 V, connected to centre phase.

.5 Terminal cabinet:

.1 NEMA 1, CSA approved.

.2 Surface mounted with hinged door and drip shield.

.3 Screw type indexed terminals.

.4 Be of suitable size and identified as required.

.5 Factory finished and provided with engraved lamacoid nameplate; review nomenclature with Contract Administrator.

.6 For each of above indications, provide two (2) minimum #12 and #12 ground in 13 mm (1/2") conduit for each function to respective terminal cabinet.

.7 Install cabinets as required, with their tops not to exceed 1800 mm (72") above floor. Determine exact quantity of cabinets based on BAS circuits in common areas located in same cabinet.

3.7 ELEVATOR EQUIPMENT POWER AND CONTROL CONNECTIONS

.1 Provide splitter trough, disconnect switches, outlet boxes, etc., as required for elevators provided as part of work of Division 14. Include for additional relays and/or contacts to interconnect with auxiliary building systems and equipment. Refer to and comply with Division 14 documents.

.2 Generally, terminate power and control wiring at elevator controllers for final connection to elevator equipment as part of work of Division 14. Confirm with elevator trades their extent of work and provide work to properly interface. Generally, interconnections and provisions are required for but not limited to following:

.1 power for elevators;

.2 power for cab interior devices;

.3 telephone and other communications for cab;

.4 signalling and fire alarm interconnections for initiating sequence of operation of elevators (ie. homing); provide fire fighter’s key switch control for takeover of elevators;

.5 telephone and miscellaneous power in elevator room;

.6 smoke/heat detectors in elevator room and pit.

.3 Obtain accurate roughing in information and carefully coordinate work with Division 14. Placing of elevating device apparatus is to take precedence over work of this Division and, with exception of fire alarm devices, work in hoistways, equipment rooms, and pits are to be confined to work serving elevating devices only.

.4 Failure to comply with above will render you responsible for relocation and adjustments as required.

.5 Provide required central control and interlocking feeders for elevator equipment indicated on drawings. Carefully coordinate exact requirements with successful elevator equipment supplier/installer prior to roughing-in.

.6 Identify each disconnect switch with labels and lettering to requirements of Division 14.

.7 Provide GFCI type 110 V convenience outlets in machine rooms and pits.

.8 Provide empty conduit with fish cords, as required from telephone head end equipment to elevator machine room for future wiring and connection by Division 14 to each elevator cab phone. Terminate on box outside elevator controller.

.9 Provide fire alarm system provisions as specified in fire alarm system Section and as specified in Division 14.

.10 Comply with latest requirements of CSA B44. Coordinate with Division 14 in obtaining required inspections and approval certificates from local authority having jurisdiction.

3.8 ELECTRICAL CONNECTIONS FOR MECHANICAL, THE CITY'S, ETC., EQUIPMENT

.1 Provide required electrical connections to apparatus provided and/or supplied by Electrical Divisions. Review shop drawings and coordinate with each equipment vendor, requirements for power feeds and control/communication interconnections and provide these requirements to complete installations work.

.2 In addition to providing electrical feeders and connections to equipment provided by Electrical Divisions, provide required electrical connections to apparatus provided and/or supplied by Mechanical Divisions, The City and as part of other Divisions.

.3 Unless otherwise noted, provide electrical connections including power and control wiring for equipment supplied by The City or by other Divisions, and except where specified for control wiring of Mechanical Divisions automatic control systems specification Section. Provide complete wired and empty conduit systems with fish cord, junction boxes, pull boxes, outlet boxes, faceplates, sleeves, etc. Provide disconnect switches, receptacles and other required wiring and connection accessories. Coordinate work with respective Contract Administrators and suppliers of equipment to be provided with electrical connections.

.4 Refer to Divisions 10 and 11 and include for coordination and interconnections of Divisions 10 and 11 requirements and equipment schedules.

.5 Coordinate with trades of other Divisions to ensure provision of proper electrical requirements. Unless otherwise noted or reviewed with Contract Administrator, be responsible for provision of interconnect wiring between remote operator devices, controllers, and equipment being controlled by operator devices, whether or not such devices/controllers are supplied by Electrical Divisions. Where equipment is of split unit design and line voltage is required to both units, be responsible for feeders to each unit as coordinated with equipment manufacturer and Division responsible for equipment. Provide disconnect switches, receptacles and other required wiring and connection accessories. Provide system/equipment power feeds with hard wired or receptacle type connections, as required. Coordinate exact requirements prior to start of work, at time of shop drawing submissions and prior to roughing-in of work. Coordinate work with suppliers of equipment to be provided with electrical connections which may include but not be limited to following:

.1 kitchen equipment;

.2 audio visual systems;

.3 telecommunication systems;

.4 mechanical systems and equipment

.5 motorized doors;

.6 For Mechanical Divisions supplied fire pumps and sprinkler pump controllers, and transfer switches, provide power and control wiring in conduit from emergency power plant (gensets) to equipment. For specific local governing code applications, conductors to be ULC listed and labelled 2-hour fire rated types. Control wiring between genset control panel and respective equipment to initiate start of gensets (start of emergency power sequence) when loss of normal power is sensed at equipment. Coordinate exact requirements with Mechanical Divisions.

.7 Provide coordination of alarm connections of equipment with Mechanical Divisions BAS Contractor. Refer to drawings of both Electrical Divisions and Mechanical Divisions for BAS points to be connected. Include for wiring in conduit, contacts, termination/junction boxes, etc., as required for inter connection.

.8 Mechanical Divisions are responsible for supply of motor starters and variable frequency drives (VFDs) (also known as variable speed drives –VSDs) and harmonic filters for motorized apparatus supplied by them and is to provide Lamacoid identification throughout. Motor starters, VFDs and/or MCCs are generally to be as scheduled. Generally, starters are supplied in following manner:

.1 loose starters for mounting adjacent to apparatus or on motor starter panels;

.2 mounted starters in factory assembled and pre-wired motor control centres;

.3 mounted starters on factory assembled and pre-wired packaged equipment.

.9 MCCs and VFDs (with harmonic filters where required) are to be supplied and set in position by Mechanical Divisions. Coordinate installation and connection requirements with Mechanical Divisions and respective equipment manufacturers. Obtain required wiring diagrams. Provide required connections.

.10 Be responsible for following work:

.1 mounting loose starters and providing "line" and "load" power connections;

.2 providing motor starter panels - conduit work at motor starter panels to be horizontally and vertically plumb; plan installation to avoid crossovers;

.3 making "line" side power connections to motor control centres and "load" side connections to motors or other apparatus supplied power from motor control centres - where applicable, sub-feed refrigeration machine starter from double lugs furnished in adjacent motor control centre for refrigeration equipment;

.4 making "line" side power connections to starters on "packaged" equipment;

.5 coordinating feeder entries to starters and starter assemblies with Mechanical Divisions;

.6 providing additional disconnect switches (complete with identification) detailed on drawings, or required by Code, or for apparatus which cannot be seen from its starter or is in excess of 9 m (30') from its starter;

.7 connections to thermistors and provision of additional relays as required for connections to starters; generally, Mechanical Divisions are to supply required thermistors and relays necessary for starters; review Mechanical Divisions specifications and/or drawings defining these requirements and include necessary work, wiring, conduit and components not being supplied by Mechanical Divisions;

.8 performing required motor starter interlocking in accordance with requirements specified and as outlined on MCC/starter schedules; coordinate interlocking requirements with Mechanical Divisions;

.9 in coordination with Mechanical Division, providing 120 VAC power feeds to receptacles and luminaires integral with mechanical equipment including air handling units;

.10 in coordination with Mechanical Division, ensure that identification nameplate is provided on each motor starter or disconnect;

.11 in coordination with Mechanical Division, ensure that identification nameplate is provided on each motor control centre nameplate is to identify name, for example, MCC No. 1, and voltage, for example, 600 V;

.12 in coordination with Mechanical Division, ensure that identification nameplate is provided and attached with stainless steel screws to each separately mounted 3-phase motor starter or group of 3-phase motor starters a suitably sized black-white-black Lamacoid nameplate engraved to read:

"MOTOR(S) IS CAPABLE OF MAKING TWO (2) STARTS IN SUCCESSION, COASTING TO REST WITH APPROXIMATELY 15 MINUTES ELAPSED TIME BETWEEN STARTS, WITH MOTOR INITIALLY AT AMBIENT TEMPERATURE, OR OF MAKING ONE (1) START WITH MOTOR INITIALLY AT A TEMPERATURE NOT EXCEEDING ITS RATED LOAD OPERATING TEMPERATURE, IF ΩK^2 OF LOAD, LOAD TORQUE DURING ACCELERATION, APPLIED VOLTAGE AND METHOD OF STARTING ARE THOSE FOR WHICH MOTOR WAS DESIGNED."

.13 Replace motors due to abuse of above prior to acceptance of work. If additional starts are required, it is recommended that none be made until conditions affecting motor operation have been thoroughly investigated and apparatus examined for evidence of excessive heating. Restrict number of motor starts to absolute minimum since life of motor is affected by number of starts.

.14 Where supplied by Mechanical Divisions and connected by Electrical Divisions, connect VFDs and harmonic filters with power, control and monitoring conductors in strict accordance with manufacturer's instructions and local governing electrical code. Provide manufacturer's recommended conductors and connectors to suit respective connected equipment (such as Nexan DriveRX type VFD cables). Provide required upstream fused disconnects or breakers and overload protection. Maintain separation of power and control conductors as per manufacturer's requirements to minimize effects of electromagnetic interference. Properly ground and bond equipment. Coordinate exact installation requirements with Mechanical Division and equipment vendors.

.11 Refer also to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

2 Products

2.1 DRY TYPE TRANSFORMERS – GENERAL REQUIREMENTS

.1 Types, capacities and ratings: as noted or scheduled on drawings.

.2 CSA approved and/or ULC listed and labelled, constructed and factory tested in accordance with applicable requirements of following:

- .1 Canadian Standards Association (CSA)
  - .1 CAN/CSA-C22.2 No.47, Air-Cooled Transformers (Dry Type).
  - .2 CAN/CSA-C802.2, Minimum Efficiency Values for Dry Type Transformers.
  - .3 CSA C9, Dry-Type Transformers.
- .2 Institute of Electrical and Electronics Engineers (IEEE)
  - .1 IEEE C57.110, IEEE Recommended Practice for Establishing Liquid Immersed and Dry-Type Power and Distribution Transformer Capability when Supplying Nonsinusoidal Load Currents.
- .3 National Electrical Manufacturers Association (NEMA)
  - .1 NEMA ST 20, Dry Type Transformers for General Applications.
- .4 National Research Council Canada (NRCC)
  - .1 NRCC SOR/2016 – 311, Energy Efficiency Regulations.
- .5 U.S. Department of Energy (DOE)
  - .1 DOE 10 CFR 431.196, Code of Federal Regulations, Energy Efficiency Program for Certain Commercial and Industrial Equipment.
- .6 Local governing authority codes and standards.

.3 After fabrication, emergency/critical power transformers to be factory cleaned, bonderized, and finished in Sherwin Williams or approved equal, orange enamel finish approved by The City and reviewed with Contract Administrator.

2.2 DRY TYPE DISTRIBUTION TRANSFORMERS

.1 Hammond Power Solutions, "Sentinel G" series dry type transformers as noted or scheduled on drawings, CSA approved and/or ULC listed and labelled. Transformers to be constructed and factory tested in accordance with applicable requirements of above codes and standards, and other local governing authority codes and standards.

.2 Transformers to be complete with:

.1 copper windings;

.2 Class "H", 220°C class, coil insulation, such that winding temperature rise to not exceed 150C°(270F°) and enclosure temperature rise not exceed 65C°(117F°) under full load in a 40°C (104°F) ambient temperature;

.3 core construction consisting of stacked laminations of high permeability silicone steel;

.4 vacuum impregnated polyester or epoxy resin;

.5 lugs or pressure type terminals to suit primary and secondary conductors;

.6 up to 15 kVA: two - 5% full capacity taps; one above normal and one below normal; taps located on primary winding;

.7 greater than 15 kVA: four - 2-1/2% full capacity taps; two (2) above normal and two (2) below normal; taps located on primary winding;

.8 an integral vibration dampening system with anti-vibration pads used between coil and core and enclosure;

.9 seismic restraint requirements to suit local governing authority requirements and codes;

.10 unless otherwise noted, basic impulse level to meet CSA C9 standards;

.11 unless otherwise noted, average sound level to meet NEMA ST-20 and CSA C9 standards;

.12 efficiency meeting or exceeding latest efficiency levels of listed above standards;

.13 unless otherwise noted, factory painted with an ANSI grey enamel finish as reviewed with Contract Administrator and approved by The City;

.14 aluminum nameplate indicating impedance rating, weight, connection diagram, style and serial number, riveted to front of enclosure.

.3 Acceptable manufacturers are:

.1 Hammond Power Solutions;

.2 Delta Group;

.3 Schneider Electric;

.4 REX Power Magnetics;

.5 Siemens;

.6 Eaton.

2.3 DRY TYPE K-RATED DISTRIBUTION TRANSFORMERS

.1 Hammond Power Solutions, "Sentinel K" series dry type transformers as noted or scheduled on drawings, CSA approved and/or ULC listed and labelled, constructed and factory tested in accordance with above codes and standards, and other local governing authority codes and standards.

.2 Transformers to be complete with:

.1 copper windings;

.2 Class "H", 220°C class, coil insulation, such that winding temperature rise to not exceed 150C°(270F°) and enclosure temperature rise not exceed 65C°(117F°) under full load in a 40°C (104°F) ambient temperature;

.3 core construction consisting of stacked laminations of high permeability silicone steel;

.4 vacuum impregnated polyester or epoxy resin;

.5 K factor 13 rating as per ANSI/IEEE C57-110;

.6 electrostatic shielding;

.7 neutral sized for twice rated current;

.8 common mode noise attenuation 60 dB minimum;

.9 lugs or pressure type terminals to suit primary and secondary conductors;

.10 up to 15 kVA: two - 5% full capacity taps; one above normal and one below normal; taps located on primary winding;

.11 greater than 15 kVA: four - 2-1/2% full capacity taps; two (2) above normal and two (2) below normal; taps located on primary winding;

.12 integral vibration dampening system with anti-vibration pads used between coil and core and enclosure;

.13 seismic restraint requirements to suit local governing authority requirements and codes;

.14 unless otherwise noted, basic impulse level to meet CSA C9 standards;

.15 unless otherwise noted, average sound level to meet NEMA ST-20 and CSA C9 standards;

.16 efficiency meeting or exceeding latest efficiency levels of listed above standards;

.17 unless otherwise noted, factory painted with ANSI grey enamel finish as reviewed with Contract Administrator and approved by The City;

.18 aluminum nameplate indicating impedance rating, weight, connection diagram, style and serial number, riveted to front of enclosure.

.3 Acceptable manufacturers are:

.1 Hammond Power Solutions;

.2 Delta Group;

.3 Schneider Electric;

.4 REX Power Magnetics;

.5 Siemens;

.6 Eaton.

2.4 ENCLOSURES AND DRIP SHIELDS

.1 Include following:

.1 for standard indoor applications: minimum NEMA 2 ventilated, drip proof enclosure with rigid end frame, removable plates, terminal compartment;

.2 for additional indoor protection and standard outdoor applications: minimum NEMA 3R enclosure with a rigid end frame, removable plates, a terminal compartment; ventilation louvres designed to prevent penetration of water spray from activated sprinklers onto live parts, and gasketted doors and component openings;

.3 for additional protection outdoor applications: minimum NEMA 4 non-ventilated, water-tight enclosure;

.4 for indoor industrial applications: minimum NEMA 12 non-ventilated, drip proof, dust-tight enclosure with rigid end frame, removable plates, terminal compartment;

.5 top mounted factory painted drip shield;

.6 bottom mounted drip tray for wall/ceiling mounted transformers;

.7 unless otherwise noted, factory painted with an ANSI grey enamel finish as reviewed with Contract Administrator and approved by The City.

3 Execution

3.1 INSTALLATION OF DISTRIBUTION TRANSFORMERS

.1 Locate transformers into position. Ensure adequate clearance is provided as per code requirements and as required for access for operation and maintenance. Ensure that there is adequate ventilation for transformers to operate as specified and that there is no transfer of heat to adjacent surfaces or equipment. Comply with manufacturer’s instructions and recommendations.

.2 Secure transformers 75 KVA and larger to a concrete housekeeping pad on Vibro-Acoustics Ltd. type "RSR" vibration isolation pads.

.3 Secure transformers smaller than 75 KVA in place on an angle wall mounting bracket support assembly located approximately 300 mm (12") below ceiling. Provide support assembly and adequately secure to wall and/or ceiling construction.

.4 Provide seismic restraints as required by local governing codes.

.5 Ensure that transformers are equipped with lugs or connections suitable for primary and secondary connections. Isolate primary and secondary connections from transformer enclosures by means of 300 mm - 450 mm (12" to 18") of liquid-tight flexible conduit. Typically, install conduit connections in lower one-third of transformer.

.6 Ground and bond equipment to ground electrode grids as per local governing electrical code and inspection authority requirements. Refer also requirements of Section entitled – Grounding and Bonding.

.7 Provide engraved Lamacoid nameplates and warning signs with nomenclature reviewed with Contract Administrator.

.8 When installation is complete, test and check secondary voltages. Make all required adjustments and submit to Contract Administrator a test report indicating secondary voltage readings and any adjustments made to achieve proper voltages. Furthermore, when building is in normal use, re-check voltages and make any required adjustments.

.9 Refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

END OF SECTION

1 General

1.1 SCOPE

.1 The switchboards have been pre-purchased by the City as part of long lead delivery items.

.2 Contractor shall install the switchboards and supply ancillary materials to complete the installation. The switchboards shall be free issue to the Contractor.

1.2 SUBMITTALS (NOT APPLICABLE)

.1 Submit shop drawings for products specified in this Section.

.2 Indicate on shop drawings:

.1 Site installation details, including close coupling with power transformer.

.2 Floor anchoring method and foundation template.

.3 Dimensioned feeders' entry and exit locations.

.4 Dimensioned position and size of bus.

.5 Overall length, height and depth of complete switchboard.

.6 Dimensioned layout of internal and front panel mounted components.

.7 Product data for all components and devices: main circuit breaker, distribution circuit breakers, etc.

.8 Section splits.

.3 Revise equipment ratings to suit coordination study and short circuit calculations reports.

1.3 WARRANTY

.1 Warranty Period: Two years, commencing upon substantial completion post installation.

.2 Switchboard components that fail in materials or workmanship shall be repaired or replaced within the specified warranty period. Warranty shall include all labor, material, and related expenses to restore system and / or components from failure.

.3 The warranty specified in this Article shall not deprive The City of rights under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the manufacturer under the requirements of the Contract Documents.

2 Products

2.1 SWITCHBOARDS – SWBD-61 (FOR REFERENCE ONLY)

.1 Switchboard requirements are specified herein with additional requirements noted on drawings and in other Sections.

.2 Switchboards to be indoor, metal enclosed, sprinkler resistant, standardized switchboards that are CSA approved and ULC listed and labelled as per local governing code requirements. Switchboards are suitable for use in building solidly grounded system with short circuit capacity as scheduled, but in absence of direction, are to suit specific application to local governing electrical code requirements.

.3 ARC FLASH REDUCTION SYSTEM

.1 Provide capability to lower the incident energy level that an operator could be exposed to during maintenance activities on energized switchgear to less than 8 cal/cm2 at 18".

.2 The solution employed for arc flash reduction depends on the breaker and other technologies of various manufacturers. Regardless of manufacturer and technology, arc energy reduction shall be automatic, activate automatically and achieved without sacrificing coordination.

.3 Acceptable technologies for arc flash sensing and incident energy reduction include fiber- optic light sensors, pressure sensors, waveform recognition (WFR), instantaneous zone selective interlocking (I-ZSI), purpose-built relays, or combinations thereof.

.4 Switchgear manufacturer shall provide documentation that details the methods by which it proposes to lower the incident energy level.

.5 System shall be compliant with requirements of CSA Z462-15.

.4 Where applicable, requirements to comply with local governing electrical utility standards and regulations for incoming electrical services.

.5 Switchboards to comply with and be manufactured in accordance with latest editions of following:

.1 CSA 22.2 No.31;

.2 ANSI-C37.20.1/C37.51;

.3 UL 891.

.6 Power circuit breakers (also referred to as air circuit breakers (ACB)) are to comply with:

.1 ANSI-C37.13/C37.16/C37.17/C37.50;

.2 UL 1066.

.7 Moulded case breakers are to comply with and be designed, manufactured and tested in accordance with applicable conditions of:

.1 C22.2 NO. 5;

.2 UL 489.

.8 Structure:

.1 Switchboard consists of individual sections bolted together to form an enclosed, self-contained, self-supporting structure with necessary facilities for proper ventilation. Sections are of modern welded or bolted construction, fabricated from sheet steel in accordance with NEMA and CSA requirements and reinforced wherever necessary to provide adequate strength. Sections to align front and rear. Front doors are formed type, fabricated with cold rolled sheet steel and complete with handle lock operators and locking tabs. Unless otherwise required, rear, top and side panels are bolt-on and secured suitably to a channel type base. Refer to drawings for specific access requirements. After fabrication, switchboard is factory cleaned, bonderized, and finished in ANSI grey enamel.

.2 Entire enclosure to be in accordance with minimum NEMA 1 or NEMA 2 requirements, and with additional sprinkler protection requirements. Top of each cell to be complete with a "drip-shield" designed to shed water without dripping on cell. Enclosures to be designed to prevent penetration of water spray from activated sprinklers, onto live components. Doors and component openings to be gasketed. Conduit entries to be sealed watertight.

.3 Full height and depth fire retardant barriers are provided in sections, from top to bottom and from front to rear to contain faults.

.4 Where required to suit onsite access restrictions, switchboard to be shipped to site in sections, and assembled on site.

.9 Future Cells:

.1 Provide bus terminations for future extensions and gasketed water-tight removable side panels to accommodate installation and connection of future cells.

.2 Where future breakers are indicated, provide bus, stationary element, CT’s, control and metering wiring, such that, only draw-out element is needed.

.3 Where required, drill and plate main bus and switchboard for provision for future extension of additional vertical cell sections at each end of switchboard.

.10 Bus Bars:

.1 Main bus bars are constructed of top quality, 98% pure, rectangular copper bars, silver plated at joints with lap type joints bolted using high strength steel bolts and extra wide, extra thick washers to ensure maximum pressure and even current distribution at each joint. Bus and connections are designed so that maximum temperature rise in any part of switchboard will not exceed 65C° (117F°) over an ambient temperature of 40°C (104°F). Bus is properly isolated and designed to carry currents as required.

.2 Continuous ground bus not less than 6 mm (1/4") x 50 mm (2") cross section area extending length of switchboard and is solidly bolted to steel framework. Ground bus is constructed of same material as main bus and is complete with suitable lugs for grounding connections outlined on drawings. Ground bus is rated for momentary current rating equal to or greater than that of apparatus in switchboard.

.3 Supply required bolts, nuts, and washers for field connection of bus joints between cells.

.11 Control Wiring:

.1 Each cell to be complete with required control wiring and terminal blocks. Control wiring is type "SIS", minimum size No. 14, extra flexible wire with thermoplastic insulation. Neatly harness and suitably secure control wiring.

.2 Terminal blocks are pressure type and complete with removable marking strips.

.3 Shorting blocks are enclosed barrier type within control cubicle.

.12 Switchboard Arrangement and Components:

.1 Switchboard cell arrangements and components are as detailed on drawings.

.2 Do not run main bussing lower than 300 mm (12") above finished floor level.

.3 Where 100% rated breakers are required, include necessary requirements.

.13 Main Breakers:

.1 Power circuit breakers, with electrically operated, stored energy, draw-out breaker assembly mounted behind a full-sized flanged type heavy gauge steel panel with a heavy-duty finger type ground contact, wheels for mounting on rails in cell, a mechanical interlock which prevents moving unit into or out of connected position while breaker assembly is closed, and a nameplate giving breaker rating. Where current limiting is required for greater interrupting rating to suit specific application, provide air circuit breakers with integral current limiting fuses as per manufacturer’s standards.

.2 Breaker assembly consists of an operating mechanism, 3-pole units, and a solid-state adjustable tripping unit. Operating mechanism provides 2-step stored energy closing. One stroke of operating handle charges spring, after which breaker may be closed by pushing a button. A tripping button and a breaker position indicator are provided. Breaker has facilities for padlocking in open position.

.3 Breakers are complete with microprocessor based solid state tripping unit having adjustable tripping functions including but not limited to, long time pick-up, long time delay, short time pick-up, short time delay; instantaneous pick-up; ground fault pick-up; and ground fault delay. Trip settings are to be as determined by distribution system testing and coordination study. Include for required trip settings and settings as required to provide coordinated protective devices throughout electrical distribution system as required by local governing electrical code and authorities.

.4 Tripping unit includes three sensors, one on each phase conductor, arranged such that a trip signal from any sensor opens all three poles of breaker.

.5 Trip unit includes LED indication of mode and trip and a display panel indicating protection function settings and system data. Unit is continuously self-checking and monitoring. Complete system selective coordination is provided with individually adjustable time/current shaping solid-state elements. Unit is with auxiliary power module for power source. Trip unit includes energy monitoring and display of peak demand, present demand and energy consumption.

.6 Main breakers are CSA, cUL ULC listed for application of 100% of its trip setting and are capable of carrying its full rated ampere capacity, indefinitely without tripping. No external source of power is to be necessary to trip breaker in event of a fault or overload. Necessary tripping energy to be derived from monitoring current transformers provided with breaker. Breaker is operated with a two-step stored energy mechanism to provide a maximum five cycle closing and is provided with colour coded breaker status indicators to indicate position of contacts.

.7 Actuator mechanically trips breaker when a tripping pulse is emitted by trip unit. When solid-state unit does not have an instantaneous tripping element, it has a discriminator feature to provide instantaneous tripping only when breaker is being closed into a fault. Trip unit includes test plug terminals to permit convenient field checking of calibration, and is equipped with long, short, instantaneous, time delay, ground fault functions and ground tripping indication determined and required to suit distribution system testing and coordination study.

.8 Draw-out contacts on power circuit breaker consists of a set of contact fingers suitably spaced on breaker studs. In connected position these contact fingers engage stationary contacts forming a current carrying bridge. Assembly provides a multitude of silver-to-silver high pressure point contacts. High uniform pressure on each finger is maintained by individual short coil springs. Entire assembly is full floating and provides ample flexibility between stationary and moving elements.

.9 Secondary disconnecting devices consist of floating fingers mounted on removable units engaging flat contact segments located at rear of compartment. Secondary disconnecting devices are silver plated to ensure permanence of contact, and contact engagement is maintained in connected and test positions. Each breaker has four (4) positions consisting of connected, test, disconnected, and removed. Breaker draw-out element contains a worm gear levering "in" and "out" mechanism with removable lever crank. Mechanical interlocking is provided so that breaker is in tripped position before levering "in" or "out" of cell. Breaker includes a provision for padlocking open to prevent manual or electric closing. Padlocking also secures breaker in connected, test, or disconnected position by preventing levering.

.10 Power circuit breakers are equipped with connection terminals suitable for connections as specifically required for applications. Draw-out cradle includes primary and control wiring disconnects.

.11 Control wiring for connections to breakers to run outside of breaker cell to greatest extent possible. Where running of control wiring is necessary within breaker cubicle, bundle conductors and mechanically secure away from breaker and draw-out mechanisms.

.12 Breakers are provided with 120 V fused secondary control circuit transformer for breaker closing and tripping current.

.13 Provide shunt trip operators, as required.

.14 Provide electrically operated breaker pushbuttons, manual trip button, breaker position indicators, breaker 'open/close' lamps, and "push to test" lights. Breaker open operators to be equipped with safety cover to prevent in advertent operation.

.15 Emergency charging handle provided for manual charging if control power is lost. A manual closing lever is included to permit closing circuit breaker with compartment door closed.

.16 Accessories supplied with breakers consist of manufacturer standard items, including three spare fuses of each type and size used in each switchboard. Control fuses are form II HRC types.

.14 Metering:

.1 PowerLogic PM8000, microprocessor based measuring and digital metering system in compliance with ANSI C12.20 Class 0.2%, to provide complete electrical metering with embedded WEB server. System measures and displays voltage, current, frequency and time, and calculates and displays kW, KWh, KW demand, ampere demand, kVA, kVA demand, kVAr, kVArh and individual current and voltage harmonics.

.2 System includes configurable event triggers that initiate alarm output. Alarm features including voltage phase loss, current phase loss, line voltage phase loss, voltage phase reversal, over voltage, under voltage and time delay.

.3 LCD/LED display is provided on unit. Unit includes inputs/outputs, contacts, RS485/MODBUS/TCP/IP Ethernet interfaces as required for communications to remote monitoring terminal or printer or BAS. Suitable current transformers, potential transformers and control wiring to be provided. Include custom clear acrylic, hinged locking cover over each unit. Review exact requirements with Contract Administrator prior to ordering.

.4 Unless otherwise noted, each air circuit power breaker to be provided with above metering system unit.

.15 Circuit Breakers Distribution Section:

.1 Electrically operated draw-out/fixed mounted power circuit breakers as specified for main breakers.

.2 Circuit breaker distribution section consists of moulded case, bolt on circuit breakers with an interrupting capacity as scheduled and frame size to suit application.

.3 Breakers to be NEMA rated types, and for switchboards, breakers when frame sized equal or greater than 200 amperes, or where scheduled or where noted on drawings, to be provided with solid state adjustable trip units with long time, short time and instantaneous time, ground fault protection (LSIG) functions and time delays. Set trip units at ratings as per coordination study as required for proper selective coordination.

.4 Size breakers as per drawings and/or schedules, but in absence of direction, size breakers to suit intended application, to suit coordination study requirements and in accordance with local governing electrical code.

.16 Switch and Fuse Distribution Section:

.1 Switch and fuse section with quick-make, quick-break, visible contact load break switches with operating handles and facilities for locking in either ON or OFF position, and unless otherwise noted, HRC Form I, Class J current limiting fuses.

.17 Current and Potential Transformers:

.1 Potential transformers (PT's) are of compartment type and incorporate current limiting fuses.

.2 Current transformers (CT's) have ratios to suit application, a mechanical rating equal to momentary rating of circuit breakers and be insulated for full voltage rating of switchboard.

.3 Current and potential transformers for local electrical utility metering are to be supplied by utility and are shipped to switchboard manufacturer's factory for factory mounting and connection.

.18 Incoming and Outgoing Conductor Connection Facilities:

.1 Provide required facilities and hardware for cable in conduit and/or bus duct as required.

.19 Surge Protective Devices (SPD):

.1 Switchboards to be complete with integral SPD unit installed in dedicated cell. Unit to be factory installed and connected onto bussing through integral disconnect as recommended by manufacturer. Unit to include diagnostic package with status indicators on each phase, LCD surge counter display, audible alarm with silence button and Form C alarm contacts. Unit to be maintenance free.

.2 Switchboards to be complete with integral surge protective devices (SPDs). Unit to be factory installed into separate cubicle section and connected onto bussing through integral disconnect as recommended by manufacturer. SPD features include following:

.1 in accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;

.2 Type 1;

.3 maximum voltage protection rating to not exceed 700 V (120/208 V) or 1500 V (600/347V): L-N, L-G, N-G; 1200 V (120/208 V) or 3000 V (600V): L-L;

.4 minimum nominal discharge current rating of 10 kA;

.5 minimum short circuit current rating of 100 kA;

.6 peak surge current 250 KA per phase;

.7 high-performance EMI/RFI noise rejection filter;

.8 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of switchgear/switchboard;

.9 diagnostic package with status indicators on each phase;

.10 LCD surge counter display;

.11 audible alarm with silence button;

.12 Form C alarm contacts;

.13 maintenance free and not require any user intervention throughout its life;

.14 standard manufacturer's minimum 5 years parts and labour warranty.

.20 Accessories:

.1 Manufacturer's standard accessories, spare parts and maintenance tool kit.

.2 Breaker lift truck (for draw-out breakers).

.3 Wall mounting spare fuse rack.

.4 Manufacturer's installation drawings.

.21 Factory Testing:

.1 Manufacturer technician to:

.1 perform standard factory testing and submit copy of detailed reports to Contract Administrator for review;

.2 The factory acceptance testing (FAT) of the switchboard will be witnessed by two The City's representatives prior to shipment. The travel and accommodation cost for the witnessing party shall be included in the cost of equipment and services for the low voltage switchboard.

.3 Notice of factory test date shall be provided thirty (30) days prior to the test date.

.4 A step-by-step Factory Acceptance Test Plan shall be prepared by the Vendor in collaboration with the manufacturer and submitted to the Engineer for review and approval not less than two (2) weeks prior to the scheduled test date. This Plan shall include the following, as a minimum:

.1 Description of test bed

.2 Elementary wiring diagram drawings

.3 Bill of material and description of the simulator equipment (if applicable)

.4 Procedure for performing the shop tests

.5 Method of collecting test data, including forms for recording checks and test results

.6 Sample test report complete with sample results and list of acceptable values.

.5 The Vendor shall attend any meetings necessary in order to explain, adjust and complete this Plan, to the satisfaction of the Design Engineer.

.6 The test facility shall be adequately equipped and staffed to perform all tests to the satisfaction of the witnessing party and within the time frame allotted and agreed upon during the bid award process.

.7 The Supplier shall provide all equipment, devices and circuitry required to simulate all operating conditions necessary to test inputs, outputs, monitoring functions and confirmation signals corresponding to the specified operations. The following documentation shall be available for reference during the factory witness test: Operation and Maintenance Manuals, Shop Drawings, Sequence of Operations and all Bid Documents.

.8 Equipment shall be inspected and completely tested operationally at the Supplier's factory to demonstrate conformance with specification requirements.

.9 Any repeated tests that require more than one (1) additional testing day beyond the mutually agreed upon base test schedule will be billed to the Contractor.

.10 All equipment shall be set up for factory testing in a spacious, well-illuminated environment to permit convenient and unobstructed operation and observation of all features, equipment and testing devices.

.11 The The City and/or the Engineer reserve the right to modify the submitted Test Plan and request additional tests at the factory.

.12 The switchboard shall be factory tested to simulate a complete and integrated system. The circuit breakers shall be installed in their actual positions and shall be electrically and mechanically tested. The tests and inspections shall include, but not necessarily be limited to, the following:

.1 Megger test with a 1000 V DC megger. The minimum acceptable value obtained shall be 100 megohms on the switchboard, with all fuses, switches, circuit breakers, and contactors in the open position.

.2 Dielectric test at 2200 V AC for one minute between live buses and ground, and between live buses, in accordance with manufacturer's standard practice.

.3 Dielectric test of wiring and control circuits at 1500 V AC for one minute, or 1800 V AC for one second, between live parts and ground

.4 Circuit continuity and wiring

.5 Mechanical equipment adjustment and operation of all moveable equipment and devices

.6 Equipment arrangements, types, and ratings for conformance with approved drawings

.7 Bus bar phasing and bracing

.8 Integrity of all electrical connections, including those between wiring connected through un-pluggable connectors

.9 Conformance with the nameplate and circuit identification indicated on the Drawings and the approved manufacturer's drawings

.10 Demonstration of switchboard functions.

.13 Dismantling and shipment from factory test bay shall not occur until deficiencies have been corrected and the system has been re-tested to the satisfaction of the Engineer, and certified as being acceptable for shipment.

.14 The Vendor shall complete and submit full report following the completion of the factory testing, and before commencing the equipment functional testing on site.

.1 Provide maintenance data for distribution switchboard for incorporation into maintenance manual,

.2 Refer to Part 3 for additional requirements.

.22 Acceptable manufacturers are:

.1 Eaton Electric

.2 Schneider Electric (Square D);

.3 ABB

2.2 STANDARD SWITCHBOARDS – SWBD-41

.1 Indoor, metal enclosed, standardized service entrance switchboard for use in a solidly grounded system with a short circuit capacity as scheduled. Switchboard is shown and scheduled on drawings and complies with latest editions of following:

.1 CSA Standard CAN/CSA C22.2 No. 31;

.2 UL 891.

.2 Moulded case breakers are to comply with and be designed, manufactured and tested in accordance with applicable conditions of:

.1 C22.2 NO. 5;

.2 UL 489.

.3 Switchboard conforms to local governing electrical authority requirements.

.4 Structure:

.1 Switchboard consists of individual sections bolted together to form an enclosed, self-contained, self-supporting structure with necessary facilities for proper ventilation. Switchboard is front accessible type needing no access from rear. Sections to align front and rear. Each section is of modern welded construction, fabricated from sheet steel in accordance with NEMA and CSA requirements and reinforced wherever necessary to provide adequate strength. Front panels or doors are formed type, fabricated with cold rolled sheet steel. Unless otherwise required, rear, top and side panels are bolt-on and secured suitably to a channel type base. After fabrication, switchboard is factory cleaned and finished with ANSI grey enamel.

.2 Entire enclosure to be in accordance with NEMA 1 or NEMA 2 requirements, and with additional sprinkler protection requirements. Top of each cell to be complete with a "drip-shield" designed to shed water without dripping on cell. Enclosures to be designed to prevent penetration of water spray from activated sprinklers, onto live components. Doors and component openings to be gasketted. Conduit entries to be sealed watertight.

.5 Future Cells:

.1 Where shown, provide bus terminations for future extensions and gasketed water-tight removable side panels to accommodate installation and connection of future cells.

.6 Bus Bars:

.1 Main bus bars are constructed of top quality, 98% pure, rectangular copper bars, silver flashed, or silver plated at joints with lap type joints bolted using high strength steel bolts and extra wide, extra thick washers to ensure maximum pressure and even current distribution at each joint. Bus and connections are designed so that maximum temperature rise in any part of switchboard will not exceed 65C° (117F°) over an ambient temperature of 40°C (104°F). Bus is properly isolated and designed to carry currents as required.

.2 Ground bus not less than 6 mm (1/4") x 50 mm (2") cross section area extending length of switchboard and is solidly bolted to steel framework. Ground bus is constructed of same material as main bus and is complete with suitable lugs for grounding connections outlined on drawings. Ground bus is rated for momentary current rating equal to or greater than that of apparatus in switchboard.

.3 Supply required bolts, nuts, and washers for field connection of bus joints between cells.

.7 Control Wiring:

.1 Each cell to be complete with required control wiring and terminal blocks. Control wiring is type "SIS", minimum size No. 14, extra flexible wire with thermoplastic insulation. Neatly harness and suitably secure control wiring.

.2 Terminal blocks are of pressure type and complete with removable marking strips.

.8 Switchboard Arrangement and Components:

.1 Switchboard cell arrangement and components are as detailed on drawings.

.2 Where 100% rated breakers are required, include necessary requirements.

.9 Metering:

.1 PowerLogic PM8000, microprocessor-based multifunction, power and energy meters with features as follows:

.1 accuracy of +/- 0.1% or better for volts and amps, and 0.2% for power and energy functions; meet accuracy requirements of IEC687 (class 0.2%) and ANSI C12.20 (Class 0.2%);

.2 provide per phase % THD (Total Harmonic Distortion) monitoring to the 40th order for voltage (reference to neutral only) and current, and provide Volts, Amps, kW, kVAR, PF, kVA, Frequency, kWh, kVAh, kVARh and 1 KYZ pulse output, on board meter limit exceeded alarms, and 512 Megabytes for data logging;

.3 include a three-line, bright red LED display;

.4 include serial communications: RS-485; of Modbus RTU, Modbus ASCII, DNP 3.0 protocols;

.5 include network communications: RJ-45 10/100 Base-T Ethernet Network port; Ethernet TCP/IP, Modbus TCP, BACnet/IP, SNMP v1 & v3 (Network), SMTP (email), HTTP, HTTPS, Atom Feed protocols;

.6 historical trend logging for graphical viewing from an embedded WEB server;

.7 to be configured and viewed from the on-board web server without the need for external software;

.8 I/O expandability through option card slot.

.2 Review exact requirements with Contract Administrator prior to ordering.

.10 Current and Potential Transformers:

.1 Potential transformers (PT's) are of compartment type and incorporate current limiting fuses.

.2 Current transformers (CT's) have ratios to suit application, a mechanical rating equal to momentary rating of circuit breakers and insulated for full voltage rating of switchboard.

.3 Current and potential transformers for local governing electrical utility metering are supplied by local governing electrical utility and are shipped to switchboard manufacturer's factory for factory mounting and connection.

.11 Main Breakers:

.1 Frame type as scheduled and as required for application, sized as scheduled, fixed mounted, solid state moulded case circuit breaker with adjustable trip unit. Provide minimum interrupting capacity as scheduled.

.2 Insulated case, frame type as scheduled and as required for application, sized as scheduled, fixed mounted, solid state circuit breaker with adjustable trip unit. Provide minimum interrupting capacity as scheduled.

.3 Breakers to be complete with "Digitrip-310" RMS sensing solid state trip unit having following adjustable tripping functions: long time pick-up, long time delay; short time pick-up; short time delay; instantaneous pick-up; ground fault pick-up; and ground fault delay. Trip settings to be as determined by distribution system testing and coordination study. Tripping unit to have three (3) sensors, one (1) on each phase conductor, arranged such that a trip signal from any sensor opens all three (3) poles of breaker.

.4 Breaker to be ULC listed for application of 100% of its trip setting and is be capable of carrying its full rated ampere capacity, indefinitely without tripping.

.12 Circuit Breaker Distribution Section:

.1 Circuit breaker distribution section consists of Series "C" moulded case, bolt on circuit breakers with an interrupting capacity as scheduled and frame size to suit application.

.2 Breakers to be NEMA rated types, and for switchboards, breakers when frame sized equal or greater than 200 amperes, or where scheduled or where noted on drawings, to be provided with solid state adjustable trip units with long time, short time and instantaneous time, ground fault protection (LSIG) functions and time delays. Set trip units at ratings as per coordination study as required for proper selective coordination.

.3 Size breakers as per drawings and/or schedules, but in absence of direction, size breakers to suit intended application, to suit coordination study requirements and in accordance with local governing electrical code.

.13 Surge Protective Devices (SPD):

.1 Switchboards to be complete with integral SPD unit installed in dedicated cell. Unit to be factory installed and connected onto bussing through integral disconnect as recommended by manufacturer. Unit to include diagnostic package with status indicators on each phase, LCD surge counter display, audible alarm with silence button and Form C alarm contacts. Unit to be maintenance free.

.2 Switchboards to be complete with integral surge protective devices (SPDs). Unit to be factory installed into separate cubicle section and connected onto bussing through integral disconnect as recommended by manufacturer. SPD features include following:

.1 in accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;

.2 Type 1;

.3 maximum voltage protection rating to not exceed 700 V (120/208 V) or 1500 V (600/347V): L-N, L-G, N-G; 1200 V (120/208 V) or 3000 V (600V): L-L;

.4 minimum nominal discharge current rating of 10 kA;

.5 minimum short circuit current rating of 100 kA;

.6 peak surge current 250 KA per phase;

.7 high-performance EMI/RFI noise rejection filter;

.8 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of switchgear/switchboard;

.9 diagnostic package with status indicators on each phase;

.10 LCD surge counter display;

.11 audible alarm with silence button;

.12 Form C alarm contacts;

.13 maintenance free and not require any user intervention throughout its life;

.14 standard manufacturer’s minimum 5 years parts and labour warranty.

.14 Incoming and Outgoing Conductor Connection Facilities:

.1 Provide required facilities and hardware including cubicle for incoming feeder, and outgoing cable in conduit feeders.

.15 Mimic Bus, Nameplates and Labelling:

.1 Red, single line vinyl bus approximately 3 mm (1/8") thick x 9 mm (3/8") wide, representing internal bussing and components, riveted to front of switchboard and extending through handles of respective breakers.

.2 Engraved Lamacoid nameplates to be secured with stainless steel screws, adjacent each panel component and identifying each component.

.3 Warning labels affixed on face of compartment doors that allow access to live components.

.4 Internally mounted devices labelled with designation matching drawings.

.5 Door mounted components suitably labelled to convey their function to operations personnel.

.6 Equipment rating plates identifying certifications and approvals and standards of compliance.

.7 Review finish colours, sizes, and nomenclature with Contract Administrator prior to ordering.

.16 Accessories:

.1 Manufacturer's standard accessories, spare parts and maintenance tool kit.

.2 Manufacturer's installation drawings.

.17 Acceptable Manufacturers are:

.1 Eaton Electric

.2 Schneider Electric (Square D);

.3 ABB

3 Execution

3.1 INSTALLATION OF SWITCHBOARDS

.1 Assemble switchboards and locate into positions. Base layout, design, connections and requirements for supplied accessories from documents and reviewed shop drawings. Carefully examine drawings and site conditions to ensure that equipment can be positioned into their designated positions, without difficulty. Install with adequate clearance as per code requirements and as required for access for operation and maintenance.

.2 Coordinate cable/bus duct (as applicable and referred to on drawings) entry location to match incoming cable/bus duct. Allow sufficient space for required cable bending radii and connections. Where bus duct is used for connections, coordinate orientation to match and provide appropriate bus duct connection flanges.

.3 Assemble individual sections of equipment in accordance with manufacturer's recommendations and instructions, and secure assembly to concrete base. Torque bus joint bolts to manufacturer's prescriptions.

.4 Provide seismic restraints as required by local governing authorities and codes.

.5 Coordinate delivery and installation of local electrical utility supplied metering transformers, as required.

.6 Arrange for equipment manufacturer to provide necessary drawings for erection and installation of equipment. In addition, if required, obtain from manufacturer necessary copies of detail, erection, etc., drawings required for approval of installation from local electrical utility and any other authority having jurisdiction. Obtain required approvals and submit copies to Contract Administrator.

.7 Install controls and displays at height of between a minimum 1200 mm (4') to a maximum of 1800 mm (6') above finished floor level.

.8 Provide alarm/communications circuits as required. Include for provision of conduits, boxes and control/signal wiring for interconnection to BAS. Coordinate with Mechanical Divisions BAS Contractor on location of BAS panel to be used for monitoring points and extend wiring in conduit from electrical equipment to location. Terminate in junction box leaving 3 m (10') of slack length of wiring (exact length to be coordinated between Mechanical and Electrical trades), for extending and termination to BAS panel by Mechanical Division BAS Contractor. Properly identify wiring and junction box.

.9 Ground and bond equipment to ground electrode grids as per local governing electrical code and inspection authority requirements. Refer also requirements of grounding and bonding article.

.10 Install and test SPD as per manufacturer’s instructions.

.11 Test remote alarms.

.12 Test key operator locks and sequence of operation.

.13 Arrange equipment in configuration as indicated on drawings and as per reviewed shop drawings.

.14 Make necessary incoming and outgoing power cable connections to equipment in strict accordance with equipment and cable manufacturer’s recommendations. Make connections and terminations, and provide bus flanges suitable for specific incoming and outgoing cables/bus ducts.

.15 Arrange for equipment manufacturer’s personnel to provide inspection and testing of equipment prior to energizing system.

.16 Provide engraved Lamacoid nameplates with nomenclature and confirm with The City and review with Contract Administrator, during shop drawing process.

.17 Confirm final finishes with The City and review with Contract Administrator, during shop drawing process.

.18 Additionally, refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

3.2 FIELD QUALITY CONTROL (SITE ACCEPTANCE TESTING - SAT)

.1 Testing Agency: Engage a qualified factory trained representative to perform specified acceptance testing.

.2 Include in bid price performance of Site Acceptance Test (SAT) before switchboard is permanently put into service, in the presence and to the satisfaction of the Engineer and the The City. Allow for possible repeats of tests or supplementary requests of any of these parties.

.3 Visual and Mechanical Inspection

.1 Compare equipment nameplate data with drawings and specifications.

.2 Inspect physical and mechanical condition, and note any deficiencies.

.3 Verify appropriate anchorage, required area clearances and correct alignment.

.4 Inspect all doors, panels, and sections for corrosion, dents, scratches, fit, and missing hardware.

.5 Verify that fuse and/or circuit breaker sizes and types correspond to drawings and coordination study.

.6 Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12. Do not loosen bolts to re-torque. Verify proper tightness only. This is to include all bus connections of switchboard sections and external connections.

.7 Compare equipment nameplate data with latest one-line diagram when available.

.8 Confirm correct operation and sequencing of electrical and/or mechanical interlock systems.

.9 Make key exchange with devices operated in off-normal positions.

.10 Lubrication

.1 Verify appropriate contact lubricant on moving current-carrying parts.

.2 Verify appropriate lubrication on moving and sliding surfaces.

.11 Inspect insulators for evidence of physical damage or contaminated surfaces.

.12 Exercise all active components.

.13 Verify that filters are in place and/or vents are clear.

.14 Inspect physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

.15 Verify that ratings of circuit breakers match drawings.

.4 Electrical Tests

.1 Perform resistance tests through all bus joints. Perform resistance tests through each circuit breaker, including the primary disconnects, with the following procedure: Racking the circuit breaker into the cell, close it and measure the resistance of each phase from the bus to the load side landing lugs. All measurements are to be made with a 100 Amp low-resistance ohmmeter.

.2 Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground, for one minute in accordance with NETA ATS Table 100.1.

.3 Perform an AC overpotential test on each bus section, each phase to phase and phase to ground with phases not under test grounded, in accordance with manufacturer's published data. If manufacturer has no recommendation for this test, it shall be in accordance with NETA ATS Table 100.2. The test voltage shall be applied for one minute. A DC overpotential test is not an acceptable substitution; the overpotential test is to be performed with AC voltage at the power frequency.

.5 Verify correct phasing rotation and perform a voltage check across the tie breaker on double-ended switchboard to insure correct bus phasing rotation and phasing from each source.

.6 Test Values:

.1 Compare bus connection resistances to values of similar connections.

.2 Bolt-torque levels shall be in accordance with NETA ATS Table 100.12 unless otherwise specified by manufacturer.

.3 Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values that deviate from similar bus by more than 50 percent of the lowest value.

.4 Insulation-resistance values for bus, control wiring, and control power transformers shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1. Values of insulation resistance higher than this table or manufacturer's minimum shall be investigated. Overpotential tests should not proceed until insulation-resistance levels are raised above minimum values.

.5 The insulation shall withstand the overpotential test voltage applied.

.7 Perform the following individual tests, verification and calibration on the switchboard and its components, prior to the final acceptance test:

.1 Operation of breakers, manual and automatic

.8 Circuit breaker tests:

.1 Test for continuity of phase and ground connections and insulation resistance (Megger) for each phase to phase and phase to ground.

.2 Verify all acceptance tests as per NETA test procedure.

.3 Any malfunctioning of the units shall be corrected and retested to demonstrate compliance.

.9 Replace defective components with new ones and correct all defects at no additional cost to the City.

.10 Demonstrate the following during the site acceptance test:

.1 Breaker operation

.11 Infrared Scanning: Contractor shall perform an infrared scan of all switchboard during commissioning.

.1 Use an infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.

.2 Prepare a certified report identifying equipment checked and describing results of scanning. Include deficiencies detected, remedial action taken, and rescanning observations after remedial action.

.12 Demonstrate functions.

3.3 INSTALLATION ASSISTANCE

.1 Contractor to inspect installation, test equipment, perform start-up and verify work: coordinate work with Contractor;

.1 be present to assist during third party testing;

.2 perform testing at times reviewed with Contract Administrator;

3.4 TRAINING

.1 Coordinate with supplier to provide 16 hours of training to The City's representatives instructions at The City's designated location in The City on system operating and maintenance.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

1.2 BREAKERS

.1 Refer to Section 26 20 00 - Part 1, for general requirements for breakers.

2 Products

2.1 DISTRIBUTION PANELBOARDS

.1 Eaton, "Pow-R-Line" series factory assembled dead front panelboards as per drawing schedules, manufactured to CSA Standard C22.2. No. 29. Generally, interrupting capacities are scheduled, but in absence of direction, provide to capacity to suit intended application and to suit local governing electrical code requirements.

.2 Circuit breaker type "PRL4B" distribution panelboards to be single or double row as required and complete with moulded case, bolt-on circuit breakers calibrated for 40°C (104°F) ambient temperature and conforming to CSA Standard C22.2 No. 5 (Note No. 1). Locate both main lugs and neutral bar at same end. Shield main lugs through a removable cover. Identify each circuit breaker adjacent breaker handle. Refer to Part 1 for requirements of breakers to be provided with solid-state adjustable trip units. Group mount circuit breakers.

.3 Switch and fuse type "PRL4F" distribution panelboards, complete with quick-make, quick-break, visible contact load break switches with operating handles projecting through dead front panel and interlocked with switch mechanism, facilities for padlocking in either ON or OFF position, and, unless otherwise noted, HRC Form I, Class "J" fuses.

.4 Distribution panelboards of rating greater than 1200 amperes rating to be series "Pow-R-Line C" switchboard types as specified in Section 26 23 00.

.5 Panelboard interior to have three flat bus bars stacked and aligned vertically with insulators laminated between phases. Insulators support and provide phase isolation to entire length of bus. A solidly bonded equipment ground bar and a neutral bar to be provided.

.6 Bus bars (phases, grounds and neutrals) to be hard drawn electrical grade copper, silver plated and extend throughout panel.

.7 Interior trim to be of dead-front construction to shield user from energized parts. Main circuit breaker and main lug interiors to be field convertible for top or bottom incoming feed.

.8 Panelboard boxes to be constructed of code gauge, hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements, complete with removable ends and wiring gutter space on sides in accordance with CSA requirements.

.9 Floor mounted enclosures to be free-standing type, reinforced as required to provide adequate strength.

.10 Include main breakers for panelboards as scheduled. Main breakers to be automatic moulded case breakers with solid state trip units as specified in Part 1 article.

.11 Enclosures located in climate-controlled areas to be minimum NEMA 1 or NEMA 2. Surface mounted panelboards to be complete with drip shield. Ventilation louvres to be designed to prevent penetration of water spray onto live components. Conduit entries to be sealed watertight. Units to be factory painted in ANSI grey enamel. Recessed backboxes (tubs) need not be finished painted. Enclosures located in non-climate-controlled areas to be minimum NEMA 3R or NEMA 4 as indicated on drawings.

.12 After fabrication, emergency/critical power panelboards to be factory cleaned, bonderized, and finished in Sherwin Williams or approved equal, orange enamel finish approved by The City and reviewed with Contract Administrator.

.13 Distribution panelboards sized 600 A and less and panelboards not located in secured electrical rooms/closets require doors. Panelboards sized up to 600A and panelboards located in unsecure areas to be complete with doors, latches, and keyed alike locks. Locks to be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. Supply minimum 2 keys with each lock.

.14 Panelboards to include for future breaker provisions as noted on schedules. Make provision for space for breakers, bussing for full panel size and where spare breakers are scheduled, breakers with required connector kits. Unused spaces provided, unless otherwise specified, to be fully equipped for future devices, including appropriate connectors and mounting hardware.

.15 Panelboards as scheduled to be complete with integral surge protective devices (SPDs). Unit to be factory installed and connected onto bussing through integral disconnect/ breaker as recommended by manufacturer. Unit to include diagnostic package with status indicators on each phase, audible alarm and Form C alarm contacts. Unit to be maintenance free. Refer to Section 26 43 00 for additional SPD requirements for distribution panelboards.

.16 Acceptable manufacturers are:

.1 Eaton;

.2 Schneider Electric (I-Line Series);

.3 Siemens Electric Ltd.

2.2 MOTOR OPERATORS FOR MOULDED CASE CIRCUIT BREAKERS

.1 For breakers as noted and as required, include electrically operated motor operators with features as follows:

.1 100% compatible with and of same manufacturer as per breaker;

.2 CSA approved, ULC listed and labelled;

.3 of type and voltage rating to suit specific applications and as recommended by breaker manufacturer;

.4 motor operator mechanism enables local and remote ON, OFF and reset switching of breaker; contains motor connected to cam drive mechanism that drives slide mechanism to operate breaker handle;

.5 internal limit switches and relays control motor operation to prevent overdriving breaker handle and prevent motor overload conditions;

.6 key provided to manually operate breaker;

.7 pull-out locking mechanism provides method for padlocking breaker handle in OFF position;

.8 cover provides visual status of breaker: ON, OFF or TRIPPED;

.9 PUSH-TO-TRIP button allows user to manually trip breaker motor operator;

.10 mounted on breaker cover within dimensions of breaker.

.2 Include required ancillary devices and mounting hardware, as required for complete installation.

.3 Acceptable manufacturers are manufacturers of breakers being motorized.

3 Execution

3.1 INSTALLATION OF DISTRIBUTION PANELBOARDS

.1 Provide distribution panelboards and install into locations and connect complete. Install panelboards with adequate clearance as per code requirements and as required for access for operation and maintenance.

.2 Install floor mounted panelboards on concrete housekeeping pads. Provide seismic restraints as required by local governing authorities and codes. Surface wall mount other panelboards, unless otherwise noted, independent of connecting conduit.

.3 Equip each panelboard with suitable lugs to accommodate main and branch conductors as scheduled. Identify panelboard and breakers with Lamacoid identification nameplate with nomenclature approved by The City and reviewed with Contract Administrator.

.4 Connect SPD in accordance with manufacturer’s instructions and with dedicated breaker.

.5 Ground and bond equipment as per local governing electrical code and inspection authority requirements. Refer also to requirements of grounding and bonding article.

.6 Additionally, refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements. Document test results and submit copy to Contract Administrator.

3.2 INSTALLATION OF MOTOR OPERATORS FOR MOULDED CASE CIRCUIT BREAKERS

.1 Refer to drawings to determine which breakers require motor operator. Coordinate work with genset controls work to provide emergency power system sequence of operation.

.2 Install and connect operators in accordance with manufacturer’s instructions to suit specific applications. Provide required installation hardware, connecting control, communication and power wiring. Install wiring in conduit.

.3 After installation, inspect, set-up, adjust, test, and verify operation in both standalone operation and in conjunction with emergency power system (paralleling and synchronization control system) testing of Section 26 32 02.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

1.2 BREAKERS

.1 Refer to Section 26 20 00 - Part 1, for general requirements for breakers.

2 Products

2.1 BRANCH CIRCUIT PANELBOARDS

.1 Eaton "Pow-R-Line" series, factory assembled dead front panelboards as per schedules, manufactured to CSA Standard C22.2 No. 29 and local governing electrical code, and designed for sequence phase connection of branch circuit breakers.

.2 As scheduled, panelboards are of types:

.1 For panels with main breaker or main lugs up to 225 A, 120/208 V: "Pow-R-Line 1", 3-phase and single phase with minimum "BAB" frame, bolt-on moulded case circuit breakers with a minimum interrupting capacity of 10 KA symmetrical at 208 V, unless otherwise scheduled. Where panelboards are schedule to include series rated provisions, provide breakers as recommended by panel manufacturer.

.2 For panels with main breaker or main lugs up to 225 A, 347/600 V: "Pow-R-Line 2", 3-phase panelboards with bolt-on moulded case circuit breakers with interrupting capacity as scheduled or in absence of direction to be of capacity for intended application to local governing electrical code requirements.

.3 For panels with main breaker or main lugs 400 A to 600 A, 120/208 V and 347/600 V: "Pow-R-Line 3", 3-phase panelboards with bolt-on moulded case circuit breakers with interrupting capacity as scheduled or in absence of direction to be of capacity for intended application to local governing electrical code requirements.

.3 Where ground fault circuit interrupting (GFCI) type breakers are required by code and/or scheduled, provide "Quicklag" ground fault, CSA Class "A", Group 1, combination thermal magnetic bolt-on circuit breakers with solid-state ground fault interrupters.

.4 Panelboards to be equipped with one (1) continuous bus bar per phase. Each bus bar to have sequentially phased branch circuit connectors limited to bolt-on branch circuit breakers. Bussing to be fully rated and of plated copper construction.

.5 Panelboards are to be complete with:

.1 NEMA 1 or NEMA 2 box, constructed of code gauge galvanized steel with removable box ends, wiring gutter space on sides; conduit entries sealed water-tight; drip shield for surface mounted panelboards;

.2 Enclosures located in non-climate-controlled areas to be minimum NEMA 3R or NEMA 4 as indicated on drawings.

.3 dead-front construction to shield user from energized parts;

.4 enclosure constructed of code gauge, hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements; trim for flush or surface wall mounting as shown; front panel to not be removable with the door locked;

.5 hinged door with concealed fasteners, concealed hinge, chrome plated door latch and keyed alike lock with key;

.6 steel frame holder and circuit directory card protected by clear acetate and secured to back of door, and Mylar circuit breaker identification strips;

.7 copper neutral bars;

.8 200% sized neutrals for panels equipped with SPD units and for panels as scheduled;

.9 solidly bonded equipment copper ground bar;

.10 high strength, set screw type, anti-turning wire connectors;

.11 current-carrying parts be insulated from ground and phase-to-phase by high dielectric strength thermoplastic;

.12 isolated ground bus for panelboards feeding electrically sensitive equipment;

.13 filler plates covering unused mounting space;

.14 non-automatic and automatic main breaker to function as an isolating switch, where shown and as required;

.15 ground fault circuit interrupting (GFCI) type breakers to feed devices as scheduled and for applications required by local governing codes;

.16 arc fault circuit interrupter (AFCI) type breakers to feed devices as scheduled and for applications required by local governing codes.

.6 Panels, doors and trim are to be factory painted with ANSI grey enamel finish. Recessed backboxes (tubs) need not be finished painted.

.7 After fabrication, emergency/critical power panelboards to be factory cleaned, bonderized, and finished in Sherwin Williams or approved equal, orange enamel finish approved by The City and reviewed with Contract Administrator.

.8 Equip breakers of frame size 225 amperes and greater, with solid state adjustable trip units.

.9 Equip circuit breakers connected to dedicated equipment or devices with handle locks.

.10 Include spare breakers as sized on schedules and future breaker provisions as noted on schedules. Future breaker provisions to include space for breakers, bussing for full panel size and where future breaker sizes are scheduled, required breaker connector kits.

.11 In addition to these requirements and scheduled load breakers, each normal power panelboard to include provisions for small power for miscellaneous mechanical loads, consisting of an additional quantity of five 15A-1p breakers, each installed and each connected to 30 m (100') 2-No. 12 plus ground in 13 mm (1/2") EMT conduit branch circuit feeders, with termination to various mechanical loads to be determined by review with Contract Administrator at time of construction.

.12 Unless otherwise scheduled or noted, include a of minimum three 15A-1P breakers to feed BAS panels.

.13 Acceptable manufacturers are:

.1 Eaton;

.2 Schneider Electric (Square D);

.3 Siemens Electric Ltd.

3 Execution

3.1 INSTALLATION OF PANELBOARDS

.1 Provide factory assembled branch circuit panelboards and install into locations and connect complete. Install panelboards with adequate clearance as per code requirements and as required for access for operation and maintenance. Load panels with breakers as scheduled and as required.

.2 Support cabinets and enclosures independent of connecting conduit, and accurately install with reference to wall finishes.

.3 Equip panelboards with suitable lugs or provisions to accommodate main and branch conductors scheduled.

.4 Coordinate with Mechanical Division trades and Contract Administrator to determine extra mechanical loads and BAS panels requiring use of specified additional 15A circuits and connect complete.

.5 Ground and bond equipment as per local governing electrical code and inspection authority requirements. Refer also requirements of Section entitled – Grounding and Bonding.

.6 Turn over to Contract Administrator, prior to application for a Certificate of Substantial Performance of Work, minimum quantity of two panelboard cabinet or enclosure keys per panelboard.

.7 Where two or more panelboards are installed in one cabinet, equip panelboards with double lugs and increase gutter capacity to accommodate additional cabling.

.8 Identify panelboard breakers in a permanent manner, and complete typed panelboard circuit directories identifying circuit number and type and location of loads supplied from each breaker with nomenclature approved by The City and reviewed with Contract Administrator.

.9 Include for spaces for future breakers, spare breakers and additional breakers for miscellaneous mechanical loads are included as per schedules and as specified.

.10 Test and verify ground fault circuit interrupting breakers as follows:

.1 demonstrate in presence of Contract Administrator that protected circuits will "trip" when a simulated ground fault is applied to "load" side of each circuit breaker/ground fault interrupter combination;

.2 megger load side neutral on GFCI protected branch circuits to ensure that neutral is not grounded on load side of GFCI;

.3 verify GFCI operation with governing authority approved GFCI tester suitable for application;

.4 provide a written report confirming that tests have been performed and that system is functioning properly.

.11 Test and verify arc fault circuit interrupting breakers as per manufacturer’s instructions.

.12 Ground and bond panel as per local electrical code requirements. Refer also to requirements of grounding and bonding article.

.13 Additionally, refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements. Document test results and submit copy to Contract Administrator.

END OF SECTION

1 General

1.1 SCOPE

.1 This specification describes the electrical and mechanical requirements for a low voltage (<5kV), ventilated, non-segregated phase metal enclosed cable bus.

1.2 REFERENCES

.1 Cable bus systems and all components shall be designed, manufactured, tested and certified in accordance with CSA 22.2 No. 273-14

.2 Only products carrying a CSA Listing or Recognized Status to CSA 22.2 No. 273-14 will be accepted

.3 Cable bus systems and all components shall fully comply to the CE Code.

.4 Cable bus systems shall have cable ampacity provisions to comply with Rule 8-104 in the CE Code.

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

.1 A factory authorized representative shall perform on-site field measurements for an accurate cable bus layout.

.2 A complete set of i) engineering drawings and ii) installation drawings shall be supplied for each system to facilitate system design and installation and include electrical detail of the conductors together with enclosure dimensions.

.3 Installation drawings shall include the following:

.4 Load to be supported at each individual indoor and outdoor support

.5 Complete Bill of Materials (BOM)

1.4 SUBMITTALS – FOR CONSTRUCTION

.1 Drawings and information for items listed in Section 1.03 shall be submitted and shall incorporate all changes made during the manufacturing process.

.2 Manufacturer shall provide field measurements, survey, and detailed drawings, and include this with scope of supply.

.3 One Complete printed set and one electronic set of installation instructions and installation drawings shall be provided with the cable bus duct system.

1.5 QUALIFICATIONS

.1 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly and the manufacturer shall be ISO 9001.

.2 Only cable bus products carrying a CSA Listing or Recognized Status to CSA 22.2 No. 273-14 will be accepted.

.3 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.6 DELIVERY, STORAGE AND HANDLING

.1 The cable bus duct shall be packaged in optimal sized sections to facilitate shipping and handling as well as minimization of installation costs.

.2 One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

2 Products

2.1 MANUFACTURERS

.1 Power Bus Way

.2 MAXIAMP Cable bus system

.3 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified certifications, ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

.4 Rigid bus bar duct, cable tray, or cables in conduit are NOT acceptable alternatives.

2.2 CABLE BUS - GENERAL

.1 Cable bus construction shall comply with all requirements in CSA 22.2 No. 273-14.

.2 The cable bus duct system shall be designed to supply the following for each system run as indicated.

.3 The cable bus duct system shall include all necessary straight sections, fittings, cable support blocks, covers, splice plates, hardware, weatherproof entrance fittings, firestops, single conductor cables, compression lugs, termination kits, external supports and other accessories as required to form a complete system.

.4 Each straight section and fitting is to be uniquely identified with an affixed label to correspond to an itemized list as shown on the installation drawing to facilitate assembly.

.5 External supports shall be:

.1 Designed to carry the weight load of the cable bus,

.2 Consider wind and snow loading conditions of the site, and

.3 Be supplied by the manufacturer.

.4 The cable bus duct system shall be assembled at the point of installation as supplied by Power Bus Way Ltd. in accordance with installation drawings provided by same.

2.3 CABLE BUS – CONSTRUCTION

In addition to the requirements in CSA 22.2 No. 273-14, the cable bus shall have the following:

.1 All load bearing members of the cable bus duct system including side rails, rungs and splice plates shall be manufactured from mill finished 6061-T6 aluminum alloy and be a minimum of 1/4" (6mm) in thickness for maximum strength and equipment bonding.

.2 The maximum allowable design stress shall not exceed 15,000 psi and a minimum design factor of safety of 2.5 shall be used.

.3 The enclosure assembly shall be mechanically fastened, and not welded.

.4 The enclosure shall be fabricated from natural, unpainted mill finish aluminum and shall be suitable for indoor and outdoor use.

.5 All enclosure hardware shall be stainless steel for maximum corrosion resistance and minimum electrical losses. Plated hardware is not acceptable.

.6 All elements of the enclosure shall be so designed to eliminate any and all sharp edges or projections that may cause injury to personnel or damage to conductors.

.7 Ventilated covers shall be manufactured from 1/8" (3mm) thick corrosion resistant aluminum. Both top and bottom covers shall be removable and fit neatly one to another without sharp edges.

.8 Cover ventilation openings shall be designed to prevent entry of foreign objects and rodents and shall not permit entry of a round rod measuring 7mm (.28") in diameter and shall permit sufficient passage of air to cool conductors below the specified conductor termination temperature.

.9 Conductor cables shall be positively secured on supports made of a minimum ½" thickness NEMA grade glass reinforced polyester (GPO-3) spaced a maximum of 30 inches (760 mm) horizontally and 18 inches (455 mm) vertically along the length of the cable bus duct. Metallic clamps, HDPE, and wood blocks are not acceptable.

.10 Conductor cable support blocks shall be designed in segments maintaining a minimum of one conductor diameter in both horizontal and vertical planes to maintain free air conductor rating.

.11 Conductor cable supports are to be retained in place using a slotted side-rail construction into which the cable support segments slide into position without requiring the use of through-type retention bolts to facilitate ease of cable installation.

.12 Enclosure fittings shall be sized to ensure that the cable bending radius is not less than that recommended by the cable manufacturer.

.13 The cable bus duct shall include a water tight seal with a minimum 2 hour fire rating when passing through fire rated walls, floors or ceilings.

.14 The cable bus duct wall penetration seal shall be weatherproof for exterior walls.

.15 Sprinkler proof switchgear shall be equipped with a water tight entry flange using CSA approved connectors.

2.4 CABLE BUS – ELECTRICAL

.1 All cables shall be:

.1 single conductor;

.2 CSA listed and approved for either RW90 or RWU90;

.3 have an FT4 vertical tray flame test rating; and

.4 suitable for indoor and outdoor use.

.2 Cables shall be phased and supported without intermediate transpositions of the cable to maintain low impedance and assure the mechanical strength necessary to prevent cable movement or damage under short circuit fault conditions.

.3 Cables shall be arranged in a phasing pattern that provides minimal interphase and intra-phase unbalance and provide an equal sharing of the load.

.4 Cables shall be new and field loaded in continuous lengths once the enclosure has been set in place and secured. There shall be no splices in any cable.

.5 Cable ampacity ratings shall use proper correction factors to conform with the maximum continuous loading requirements as per Rule 8-104 of the CE Code.

.6 Enclosure shall be grounded at sufficient points to prevent a potential above ground on the enclosure in the event of a fault.

.7 NEMA 2-hole compression type lugs with shall be used exclusively at the termination of the conductor runs and shall be provided by the manufacturer.

.8 The enclosure shall have a resistance across the enclosure splice that shall not exceed 40 microhms.

.9 Each fitting and section of enclosure shall be bonded by the bolted joint between sections.

.10 A bonding conductor shall be provided in accordance with the CE Code and shall be sized in accordance with Table 16.

3 Execution

3.1 INSTALLATION

.1 The installer shall install the cable bus and all accessories per the manufacturer's installation manual.

3.2 WARRANTY

.1 The manufacturer shall provide a twenty-four (24) month warranty from the date of shipment against any cable bus failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

2 Products

2.1 SUB-METERING

.1 Provision of microprocessor based CSA approved Power Measurement PML ION 7300 digital sub-metering system to measure and display voltage, current, frequency and time, and calculate and display kW, kWh, kW demand, ampere demand, kVA, kVA demand, kVAr and kVArh.

.2 An LCD/LED display screen to be provided on unit.

.3 System to include required inputs/outputs, contacts, RS232/Ethernet interface for communications to remote printer, LAN or building automation system (BAS), current transformers, potential transformers and control wiring as required.

.4 Metering to be suitable for operation on 120/208 VAC and 600 VAC. Refer to single line diagram.

.5 Meters to be installed in locations as shown on drawings. Mount in locations, connect, and test for proper operation. Comply with manufacturer’s installation instructions.

2.2 BASIC CHECK METERING

.1 Itron Inc., "Sentinel" series, solid state, electronic, multi-measurement, polyphase meters, Measurement Canada approved and as follows:

.1 +/-0.2 accuracy device capable of displaying a wide range of register information as well as complying with requirements of ANSI C12.20: 1997 for Class 0.2 meters;

.2 analogue-to-digital conversion and measurement processing;

.3 register, load-profile, real-time clock and communications processing;

.4 input and output board for pulse accumulation or event notification;

.5 five (5) measurement levels;

.6 upgradable firmware;

.7 error and event logging;

.8 flexible configuration for various metering applications;

.9 autoranging power supply;

.10 register data and program information are retained in non-volatile memory in event of a power failure;

.11 liquid Crystal Display (LCD) that is programmable by user;

.12 energy measurements and Calculations: Wh, VARh, VAh, A2h, V2h, Ah and Vh;

.13 demand measurements: instantaneous values updated every second; maximum, present, previous, projected, cumulative, continuous cumulative and coincident demand values;

.14 pulse output and inputs;

.15 PF (average/minimum/instantaneous);

.16 RS232/RS485 and Ethernet communications;

.17 factory programmed to provide custom requirements of The City to suit specific onsite applications;

.18 jaws and sockets as required;

.19 CT's/PT's as required;

.20 auxiliary outputs for monitoring connection.

.2 Meters and accessories to operate at voltages, as required.

.3 Include for complete installation, connection, and testing to manufacturer's instructions and recommendations to suit specific project requirements and site conditions.

.4 Acceptable manufacturers are:

.1 Itron;

.2 PML – Schneider Electric;

.3 QMC;

.4 Carma Industries.

3 Execution

3.1 INSTALLATION OF CHECK METERING

.1 Provide meters, sockets and ancillary devices and connect complete.

.2 Install components in accordance with manufacturer's instructions to suit specific installation requirements.

.3 Install current transformers to encircle conductors.

.4 Install wiring in conduit and required devices in accordance with recommendations of product manufacturers.

.5 Test and adjust to manufacturer's requirements.

.6 Obtain required approvals/inspections for metering subject to local governing authority regulations.

3.2 TRAINING

.1 Manufacturer's trained technician to perform onsite training of each user (including the provision of user guides) prior to project completion to ensure that users are properly trained in the operation and maintenances of system.

.2 Refer to Instructions to The City specified in Section entitled Electrical Work General Instructions.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

.2 Submit samples of each typical wiring device, faceplates, finishes and colours. Mount to sample board, clearly labelling devices and finishes. Submit for review with Contract Administrator. Do not order any device unless finishes have been approved by The City and reviewed with Contract Administrator.

2 Products

2.1 SWITCHES

.1 Switches to be CSA approved, ULC listed and labelled devices.

.2 Hubbell Canada Inc., HBL 1221 Series, CSA approved, heavy duty, industrial grade, back, and side wired, AC quiet action toggle type, 20 ampere, 120-277 V switches. Switches to include steel-nickel plated bridge, nylon toggle, one-piece rivetless copper alloy spring contact arm and terminal plate, silver cadmium oxide contacts, brass binding head screws, one-piece integral grounding terminal and stainless-steel automatic grounding clips. Provide single way, 2-way, 3-way, and key type to suit specific application requirements.

.3 Hubbell Canada Inc., HBL 181221CN Series, CSA approved, extra heavy duty, industrial grade, back and side wired, AC quiet action toggle type, 20 ampere, 347 V switches. Switches to include steel-nickel plated bridge, nylon toggle, one-piece rivetless copper alloy spring contact arm and terminal plate, silver cadmium oxide contacts, brass binding head screws, one-piece integral grounding terminal and stainless-steel automatic grounding clips.

.4 Hubbell Canada Inc. No. 1221-IL, CSA approved, heavy duty, specification grade, AC quiet action, illuminated polycarbonate handle toggle type, 20 ampere, 120-277 V switches.

.5 Legrand - Pass & Seymour, No. 1200 series, pressure sensitive door switches complete with metal box, plates, and wire leads, and suitable for flush installation. Light is "ON" when door is open.

.6 Crouse-Hinds Series EDS, CAS approved, hazardous location, explosion proof surface mounting, front operated switches. Devices to be suitable for Class 1 Division 2 applications, unless otherwise noted by Contract Administrator. Exact classification to be confirmed with Contract Administrator prior to ordering. Coordinate receptacle requirements with The City to ensure compatibility with plugs.

.7 Acceptable manufacturers are:

.1 Hubbell Canada Inc.;

.2 Eaton - Cooper Wiring Devices (Arrow Hart);

.3 Legrand - Pass & Seymour;

.4 Leviton.

2.2 RECEPTACLES

.1 Receptacles to be CSA approved, ULC listed, certified and labelled devices.

.2 Hubbell Canada Inc., No. HBL5262 / HBL5362 CSA approved, ULC listed, extra heavy duty, specification grade, back and side wired, flush, nylon face/body construction, duplex U-ground, 15/20 ampere, 125 V, 2-pole, 3-wire grounding receptacles complete with one piece nickel-plated brass mounting strip with integral grounding clips, ground retention clips, nickel-plated brass wiring clamps with nickel-plated brass screws, front circuit identification area and reinforced thermoplastic base.

.3 Hubbell Canada Inc., No. HBL 5361 series, extra heavy duty, specification grade, flush, nylon face, single, 20 ampere, 125 V, 3-wire grounding receptacles.

.4 Hubbell Canada Inc., No. HBL 5461 series, extra heavy duty, specification grade, flush, nylon face, single, 20 ampere, 250 V, 2-pole 3-wire grounding receptacle.

.5 Hubbell Canada, No. HBL5262SA / HBL5362SA "CIRCUITGUARD" Series, specification grade, 15/20 ampere, 125 V, duplex, surge suppression receptacles in blue finish, complete with light and alarm, 240 joules/15000A per mode.

.6 Hubbell Canada, No. IG5262SA / IG5362SA "CIRCUITGUARD" Series, specification grade, 15/20 ampere, 125 V, duplex, isolated ground, surge suppression receptacles in blue finish, complete with light and alarm, 240 joules/15000A per mode.

.7 Hubbell Canada Inc., No. BR15TR series, commercial specification grade, 15 ampere, 125 V, 2-pole, 3-wire grounding, tamper-resistant (safety shutter) duplex receptacles.

.8 Hubbell Canada, No. GFR 5262SG / GFR 5362SG "AUTOGUARD" Series, extra heavy-duty grade, 15/20 ampere, 125 V, duplex, ULC Class "A", Group One, tamper resistant, weather resistant ground fault circuit interrupting receptacles complete with automatic self-test diagnostics, green power ON LED, red ground fault LED and 10ka short circuit current rating.

.9 Hubbell Canada Inc., No. HBL2152 / HBL2162 "Extra Heavy-Duty Style Line" decorator series, CSA approved, ULC listed, back and side wired, nylon face/body construction, 15/20 ampere, 125 V, 2 pole, 3 wire grounding, duplex receptacles complete with wrap around galvanized steel mounting strip and oversize terminal screws.

.10 Hubbell Canada Inc., No. DR15TR / DR20TR "Commercial Style Line" tamper resistant, specification grade, decorator series, CSA approved, ULC listed, back and side wired, nylon face/body construction, 15/20 ampere, 125 V, 2 pole, 3 wire grounding, duplex receptacles complete with wrap around galvanized steel mounting strip and oversize terminal screws.

.11 Hubbell Canada Inc., No. USB 15AC series, CSA approved, ULC listed, 2- USB ports (5A, 5V DC, type A and type C port configurations, class 2.0, 3.0 and 3.1) and15/20 ampere, 125 V rated duplex decorative style power receptacles, tamper resistant, back and side wired. Confirm exact USB port configuration and 15A or 20A power receptacle requirements with The City prior to ordering.

.12 Legrand - Pass & Seymour, No. 2122, 15 ampere, 125 V, recessed, ivory clock hanger receptacles and wall plates.

.13 Hubbell Canada Inc., No. 9430, EEMAC type 14-30R, 30 ampere, 125/250 V, 3-pole, 4-wire single electric clothes dryer receptacles with steel faceplates.

.14 Hubbell Canada Inc., No. 9450, EEMAC type 14-50R, 50 ampere, 125/250 V, 3-pole, 4-wire single electric range receptacles with steel faceplates.

.15 Hubbell Canada, No. IG 5262, heavy duty, specification grade, 15 ampere, 125 V, duplex, orange colour, nylon construction, back, and side wired isolated receptacles.

.16 Hubbell Canada, No. BR15TR series, specification grade, 15 ampere, 125 V, 2-pole, 3-wire, tamper resistant, safety shutter receptacles.

.17 Hubbell Canada, No. 4710, specification grade, 15 ampere, 125 V, single, 2-pole, 3-wire grounding twist lock receptacle.

.18 Hubbell Canada, No. 15 ampere and 50 ampere receptacles complete with neutral and ground conductors required for indicated number of phases as required.

.19 Crouse-Hinds ENR series hazardous location explosion proof receptacles. Devices to be suitable for Class 1 Division 2 applications, unless otherwise noted by Contract Administrator. Exact classification to be confirmed with Contract Administrator prior to ordering. Coordinate receptacle requirements with The City to ensure compatibility with plugs.

.20 Where noted that 20 A receptacles are required, include for "T" slot type of respective series of receptacles.

.21 Colour of special switches and receptacles (unless specified above), to be as specified in PART 3 of this Section of Specification.

.22 Special switches and receptacles not specified above are to be specified on drawings. Low voltage lighting controls are specified in Section entitled Lighting Control.

.23 Acceptable manufacturers are:

.1 Hubbell Canada Inc.;

.2 Eaton - Cooper Wiring Devices (Arrow Hart);

.3 Legrand - Pass & Seymour;

.4 Leviton.

2.3 FACEPLATES

.1 Grade 18 8, type 302/304, 1 mm (0.032") thick stainless steel, satin, brushed or natural finish, complete with a peel off protective plastic film, and stainless steel screws.

.2 Grade 18 8, type 430, 1 mm (0.032”) thick stainless steel, satin, brushed or natural finish, complete with a peel off protective plastic film, and stainless steel screws.

.3 Legrand - Pass & Seymour, "Jumbo" 302 stainless steel wallplates.

.4 Hubbell Canada Inc., No. HBLSS84X, NEMA 4X rated, CSA approved, ULC listed and labelled, single gang, vertical/horizontal mounting, weather-proof in-use, gasketted, cast aluminium faceplates for GFI receptacles in wet locations as indicated on drawings.

.5 Hubbell Canada Inc., No. WP8E / WP8EH, NEMA 3R rated, CSA approved, ULC listed and labelled, single gang, vertical/horizontal mounting, weather-proof in-use, gasketted, cast aluminium faceplates for standard duplex receptacles in wet locations as indicated on drawings.

.6 Hubbell Canada Inc., No. WP26E/WP26EH, NEMA 3R rated, CSA approved, ULC listed and labelled, single gang, vertical/horizontal mounting, weather-proof in-use, gasketted, cast aluminium faceplates for GFI receptacles in wet locations as indicated on drawings.

.7 Hubbell Canada Inc., No. HBL1795, ULC listed and labelled, single gang, vertical mounting, weather proof in-use, gasketted, clear bubble plate, silicone rubber faceplates for standard AC toggle switches in wet locations.

.8 Galvanized steel stamped faceplates.

.9 Hubbell Canada Inc., forged brass "S" Series faceplates with flip open doors for receptacles.

.10 Colours and finishes of faceplates are specified in Part 3 of this Section.

.11 Acceptable manufacturers are as per switches and receptacles.

2.4 PUSHBUTTONS OPERATORS

.1 Rockwell Automation (Allen-Bradley) Ltd., 800T Series operators as follows:

.1 emergency off pushbuttons: oversized 60 mm (2-1/2") diameter red plastic mushroom head pushbutton with shroud, thrust washer, and an aluminum faceplate with "EMERGENCY POWER OFF" identification lettering or other nomenclature as required to suit application;

.2 pushbuttons: standard 30 mm (1-1/4") diameter plastic pushbuttons in Red/Green colours as required for application, momentary/maintained/2 position push-pull operations as required, flush/extended/mushroom heads; non-illuminated/illuminated, with aluminum faceplate with identification lettering nomenclature as required to suit application;

.3 selector switches: 30 mm (1-1/4") diameter standard knob selector switches, 2/3 position maintained contact operations; non-illuminated, with aluminum faceplate with identification lettering nomenclature as required to suit application;

.4 key operated switches: standard 30 mm (1-1/4") diameter key cylinder lock operator, 2 or 3 position operations; non-illuminated, with aluminum faceplate with identification lettering nomenclature as required to suit application;

.5 pilot lamps: 30 mm (1-1/4") diameter illuminated LED pilot lights, red/green/amber/white/clear colours as required to suit application; of voltage ratings as required to suit application; with contact block; with aluminum faceplate with identification lettering nomenclature as required to suit application; push to test feature where required;

.6 with enamel painted steel or stainless steel faceplate for flush mounting onto recessed wall boxes or in millwork, suitable for mounting of devices;

.7 with NEMA 1 box for surface mounting applications in climate controlled areas, CSA approved for application and of size suitable for mounting of devices;

.8 with minimum NEMA 3R box for surface mounting applications in non-climate controlled areas, CSA approved for application and of size suitable for mounting of devices;

.9 with STI type flip open polycarbonate tamper-proof cover and audible alarm device activated when cover is open, and custom labelling.

.2 Exact type and ratings of devices are to suit specific applications.

.3 Acceptable manufacturers are:

.1 Rockwell Automation (Allen-Bradley);

.2 Eaton (Cutler-Hammer);

.3 Square D;

.4 GE.

2.5 DROP CORD ASSEMBLIES

.1 Hubbell Wiring – Kellems, CSA approved, drop cord assemblies including but not limited to following:

.1 ceiling mounted junction/outlet box;

.2 Kellems type strain relief grips and bus drop / drop cord grips to prevent tension being transmitted to ceiling boxes/conduit, and joints and terminations of cord;

.3 type SO, CSA approved, ULC listed and labelled, yellow neoprene jacket, oil resistant, 300 VAC rated, minimum No. 12 AWG conductors, drop cord;

.4 Appleton No. RE PPB non-conductive rubber and plastic power outlet box with duplex 15A-125V receptacle and matching to box gasketted faceplate.

.2 Acceptable manufacturers are:

.1 Hubbell;

.2 Appleton;

.3 Cooper B-line.

2.6 OUTDOOR POWER OUTLET PEDESTAL

.1 Hubbell Canada, no GFCIPK0915A13547, CSA approved, outdoor weatherproof power outlet pedestal with features as follows:

.1 weatherproof-in use aluminum receptacle cover;

.2 75 mm x 75 mm x 225 mm H (3" x 3" x 9") aluminum pedestal in weatherproof finish reviewed with Contract Administrator prior to ordering;

.3 aluminum pedestal cap;

.4 GFCI duplex receptacle;

.5 grounding lug;

.6 corrosion resistant hardware including carriage bolts, nuts and mounting screws;

.7 gasketted wiring access;

.8 drain hole;

.9 base mounting detail template.

.2 Acceptable manufacturers are:

.1 Hubbell Canada;

.2 Arlington Industries.

3 Execution

3.1 INSTALLATION OF SWITCHES

.1 Provide devices and install in electrical outlet boxes. Refer to drawings to determine flush or surface mounting requirements. Generally, flush mount devices in finished areas. Size electrical boxes to suit device requirements as per device manufacturer's recommendations. Properly ground device to box and ground system as per code requirements and manufacturer's instructions.

.2 For pricing only, switches to be ivory for devices connected to normal power circuits, red for devices connected to essential power circuits.

.3 Every switch connected to essential (emergency) power circuits, to be illuminated toggle type.

.4 Illuminated operation of lighted switches to suit specific applications as confirmed with Contract Administrator.

.5 Ensure that switches located adjacent to doors are located at strike side of door. Confirm door swing requirements on architectural drawings, not on electrical drawings.

.6 Coordinate installation of door switches with trades responsible for provision of doors and frames. Review exact locations of switches with Contract Administrator to ensure optimum operation of switch to door position.

.7 Review final device finishes with Contract Administrator as per sample board submission specified in Part 1. Do not order any devices unless final finishes have been approved by The City and reviewed with Contract Administrator.

.8 Additionally, refer to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

3.2 INSTALLATION OF RECEPTACLES

.1 Provide devices and install in electrical outlet boxes. Refer to drawings to determine flush or surface mounting requirements. Generally, flush mount devices in finished areas. Size electrical boxes to suit device requirements as per device manufacturer's recommendations. Properly ground device to box and ground system as per code requirements and manufacturer's instructions.

.2 For pricing only, receptacles to be ivory for devices connected to normal power circuits, red for devices connected to essential power circuits.

.3 Install USB charger receptacles in extra deep boxes in accordance with manufacturer's recommendations.

.4 Install exterior receptacles in accordance with drawing details, and as coordinated and reviewed with Contract Administrator. Comply with local governing electrical code with regards to wiring and installation requirements. Properly ground installations.

.5 Provide typed label identifying circuit number and panelboard from where each device is fed, permanently identified at outlets. Review exact location for identification with Contract Administrator.

.6 Where receptacles are indicated in counters and benches, box cut-out to be provided in counter and bench. Provide a box, receptacle, plate and branch circuit wiring. Branch circuit wiring within counters and benches to be flexible armoured cable, under requirements of local governing electrical code and standards. Install and connect complete.

.7 Review locations and nomenclature of nameplates and labelling with Contract Administrator prior to printing of labels and nameplates. Turn over label maker to Contract Administrator/The City prior to application for Certificate of Substantial Performance of the Work.

.8 Review final device finishes with Contract Administrator as per sample board submission specified in Part 1. Do not order any devices unless final finishes have been approved by The City and reviewed with Contract Administrator.

.9 Additionally, refer to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

3.3 INSTALLATION OF FACEPLATES

.1 Provide each device with a faceplate with an opening or openings suitable for device it conceals and covers openings around boxes. Secure faceplates to device frames with screws to match faceplates. Provide larger than standard type faceplates for devices that require engraved nomenclature to define special purpose for that device.

.2 Provide nylon type standard size faceplates for flush mounted devices.

.3 Provide stainless steel type standard size faceplates for flush mounted devices for NEMA 3R or NEMA 4X rated faceplates.

.4 Provide galvanized stamped steel faceplates in service areas and equipment rooms where devices are surface mounted.

.5 Isolated ground receptacles connected to circuits fed from uninterruptible power supply units to be equipped with faceplates in orange colour.

.6 Provide faceplates for computer equipment isolated ground receptacles with label printed with "Computer Equipment Only" lettering.

.7 Provide faceplates for housekeeping receptacles with label printed with "Housekeeping Only" lettering.

.8 Provide weatherproof insulated faceplates with hinged and gasketted receptacle access flaps for weatherproof receptacles denoted "WP" on drawings.

.9 Generally, oversized faceplates to be provided where engraved lettering is required.

.10 Faceplates for flush floor mounted receptacles in standard floor boxes to be forged brass rectangular faceplates.

.11 For flush mounted devices, provide oversized faceplates as required to properly cover wall openings around recessed boxes.

.12 Provide faceplates with suitable identification labels. Review exact locations for labelling with Contract Administrator.

.13 In addition to identification requirements specified with devices, provide faceplates with printed self-adhesive label on inside face identifying circuit number and panel feeding device. Turn over label maker to Contract Administrator prior to application for Certificate of Substantial Performance of the Work.

.14 Review exact material, finish, and colour of faceplates for devices in any particular area with Contract Administrator prior to ordering. Submit sample board as per requirements of Part 1.

3.4 INSTALLATION OF PUSHBUTTON OPERATORS

.1 Provide specified and suitable pushbutton operators and pilot lamps to suit various applications.

.2 Where flush mounted, provide faceplate for mounting onto recessed boxes.

.3 Where surface mounted climate controlled areas, provide suitable NEMA 1 box. In non-climate controlled areas, surface mounted devices to be mounted within minimum NEMA 3R rated boxes.

.4 Install devices in accordance with manufacturer’s instructions to suit application requirements of The City. Connect complete to respective equipment being controlled. Provide required wiring in conduit.

.5 Test and verify operation of each device. Provide engraved lamacoid nameplate to identify system being operated and any special instructions. Confirm exact nomenclature with Contract Administrator prior to ordering.

3.5 INSTALLATION OF DROP CORD ASSEMBLIES

.1 Provide ceiling mounted Kellams type relief grips to support cables at ceiling and relief grips at both end box terminations. Install drop cord grips to coiled cord and secure grip eyes to ceiling slab as required. Refer to manufacturer’s selection charts to determine appropriate grips to meet requirements of applications.

.2 Install devices in accordance with manufacturer’s instructions.

.3 Test to verify proper operation. Adjust as required.

3.6 INSTALLATION OF OUTDOOR POWER OUTLET PEDESTALS

.1 Prior to start of Work, confirm and coordinate with General Trades Contractor, work required for underground conduit runs including excavation and backfilling work and provision of concrete base. Obtain base detail from pedestal manufacturer.

.2 Confirm exact locations of pedestals prior to roughing in. Locate into position and install in accordance with manufacturer's instructions. Coordinate installation with trades pouring concrete floor slab.

.3 Refer to manufacturer's installation drawings. Install complete with required connection wiring. Secure to concrete pad with manufacturer's recommended bolts.

.4 Apply weatherproofing sealant as per manufacturer's instructions.

.5 Ground and bond boxes to local governing electrical code requirements.

.6 Test assembly to verify proper operation.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

.2 Submit samples of each device and colour finishes.

2 Products

2.1 NON-METALLIC SERVICE FLOOR BOXES

.1 Legrand Wiremold, “Mudulink 880MP2” series, CSA approved, UL scrub water compliant, ULC listed and labelled, fully assembled and pre-wired, flush floor, non-metallic, PVC rectangular fitting assembly as follows:

.1 modular single gang box 105 mm W x 140 mm L x 152 mm H (4" x 5-1/2" x 6"); connected together for 2 and 3 gang configurations; note that depth to suit floor slab restrictions as reviewed with Contract Administrator;

.2 50 mm (2") dia conduit stub with reducers down to 13 mm (1/2") for data/AV communication cabling and power cabling conduits;

.3 floor box adjusting ring;

.4 single, 2 and 3 gang, heavy duty metal cover plates with hinged doors; coverplate finish compatible with floor construction as approved by The City and reviewed with Contract Administrator;

.5 coverplates with specification grade 15 ampere or 20 ampere duplex receptacles, as required; and mounting bracket for provision of voice/data jacks, as required.

.2 Coordinate dimensions of assembly with thickness of floor/ceiling slab. Exact requirements of devices to be provided as required for specific applications. Flush heads must be provided unless otherwise approved by The City and reviewed with Contract Administrator. Review type of floor with Contract Administrator prior to ordering and provide coverplate to suit floor type.

.3 Refer to drawing details and notes for additional device requirements. Provide duplex receptacles to standards as specified in wiring devices article. Refer to drawing details and notes for device requirements. Coordinate AV requirements and telecommunication jack types and installation requirements with respective system subcontractor responsible for work of AV and structured cabling system.

.4 Acceptable manufacturers are:

.1 Legrand Wiremold;

.2 Hubbell Canada Inc;

.3 Thomas & Betts;

.4 Wellmark;

.5 Nocom.

2.2 POKE THROUGH FLOOR ASSEMBLIES (100 MM)

.1 Hubbell Canada Inc., "SystemOne FRPT" series, CSA approved, UL scrub water compliant, ULC listed and labelled for two (2) hour fire resistance rating, fully assembled and pre-wired, flush floor poke through fitting assembly as follows:

.1 100 mm (4") core hole, through floor fitting with adjustable smoke and fire barriers;

.2 recessed 100 mm (4") cover of die-cast aluminum construction; with single fold under cable egress door, carpet gasket and mounting hardware; cover finish approved by The City and as reviewed with Contract Administrator prior to ordering;

.3 150 mm (3") deep user chamber for recessed connectivity and with dividers;

.4 one - 20 mm (3/4") dia EMT conduit channels for power and two - 13 mm (1/2") dia EMT conduit for low voltage communication cabling;

.5 hideway egress doors fold under cover while in use; 180 degree opening of main door;

.6 sub-plates with mounting for single gang receptacle and mounting bracket for provision of voice/data jacks as coordinated with telecommunication vendor and as required;

.7 integral junction box.

.2 Coordinate dimensions of assembly with thickness of floor/ceiling slab. Exact requirements of devices to be provided as required for specific applications. Flush heads must be provided unless otherwise reviewed with Contract Administrator. Review type of floor with Contract Administrator prior to ordering and provide coverplate to suit floor type;

.3 Refer to drawing details and notes for additional device requirements. Provide duplex receptacles to standards as specified in wiring devices article. Refer to drawing details and notes for device requirements. Coordinate telecommunication jack types and installation requirements with telecommunications structured cabling system contractor responsible for work of structured cabling systems.

.4 Acceptable manufacturer is Hubbell Canada Inc.

2.1 POKE THROUGH FLOOR ASSEMBLIES (150 MM)

.1 Hubbell Canada Inc., "SystemOne FRPT" series, CSA approved, UL scrub water compliant, ULC listed and labelled for two (2) hour fire resistance rating, fully assembled and pre-wired, flush floor poke through fitting assembly as follows:

.1 150 mm (6") through floor fitting with smoke and fire barriers;

.2 recessed 150 mm (6") cover of die-cast aluminum construction; with single fold under cable egress door, carpet gasket and mounting hardware; cover finish approved by The City and as reviewed with Contract Administrator prior to ordering;

.3 163 mm (3.5") deep user chamber for recessed connectivity and with dividers;

.4 50 mm (2") dia EMT conduit for data/AV communication cabling and 20 mm (3/4") dia EMT conduit channels for power;

.5 hideway egress doors fold under cover while in use; 180 degree opening of main door;

.6 dual gang center sub-plates with specification grade 15 ampere or 20 ampere duplex receptacles, as required; and mounting bracket for provision of voice/data jacks, as required;

.7 junction box;

.2 Coordinate dimensions of assembly with thickness of floor/ceiling slab. Exact requirements of devices to be provided as required for specific applications. Flush heads must be provided unless otherwise reviewed with Contract Administrator. Review type of floor with Contract Administrator prior to ordering and provide coverplate to suit floor type.

.3 Refer to drawing details and notes for additional device requirements. Provide duplex receptacles to standards as specified in wiring devices article. Refer to drawing details and notes for device requirements. Coordinate telecommunication jack types and installation requirements with telecommunications structured cabling system contractor responsible for work of structured cabling systems.

.4 Acceptable manufacturers are:

.1 Hubbell Canada Inc;

.2 Legrand Wiremold;

.3 Thomas & Betts.

2.2 FLOOR BOXES AND SERVICE FITTINGS

.1 Wellmark Electric Inc "FM" series, CSA approved, low profile service fittings as follows:

.1 16 gauge galvanized steel floor monument base of 63 mm (1-3/4") height with welded corners;

.2 16 gauge steel epoxy coated covers;

.3 knockouts on top suitable for multi-gang receptacles;

.4 barriered power/communication sections;

.5 side knockouts for conduit entries;

.6 device plates and brackets as required.

.2 Legrand Wiremold "Walker 505 Series", die cast aluminum with satin finish, surface floor mounted service fittings with all required accessories, as follows:

.1 telephone outlets with telephone bushing;

.2 back-to-back telephone bushings and data openings;

.3 one (1) 15 ampere, 125 volts duplex U-ground receptacle and one (1) side blank;

.4 two (2) 15 ampere, 125 volts duplex U-ground receptacles, back-to-back;

.5 cast iron fully adjustable (before and after pour), flush floor box complete with removable top.

.3 Hubbell Canada Inc., "LO-CON", CSA approved, ULC listed and labelled, above floor service fitting as follows:

.1 single service;

.2 low profile design that mounts to standard electrical boxes;

.3 die cast aluminium frame with brushed aluminum housing;

.4 stainless steel faceplates consisting of following types as required;

.1 single receptacle;

.2 duplex receptacle;

.3 decorative style;

.4 furniture feed;

.5 telephone bushing;

.6 knockout for coaxial cable;

.7 blank.

.5 specification grade power receptacles;

.6 mounting bracket for provision of voice/data jacks.

.4 Hubbell Canada Inc., "Pedestal" type, CSA approved, ULC listed and labelled, above floor service fitting as follows:

.1 single service;

.2 single rectangular shaped or 2-gang square shaped;

.3 4-gang housing with 2 on front and 2 back;

.4 hub on end that mounts to electrical boxes;

.5 brushed aluminium housing;

.6 stainless steel faceplates consisting of following types as required;

.1 single receptacle;

.2 duplex receptacle;

.3 decorative style;

.4 blank.

.7 specification grade power receptacles;

.8 mounting bracket for provision of voice/data jacks.

2.3 LARGER FLOOR BOXES AND SERVICE FITTINGS

.1 Legrand Wiremold "Resource RFB4E" multi-service series, CSA approved, flush floor box as follows:

.1 4-independent wiring compartments that allow capacity up to 4 duplex power receptacles and/or communication brackets for telecommunications services;

.2 steel construction;

.3 cast iron version suitable for on-grade applications;

.4 steel version suitable for above grade applications;

.5 suitable for concrete and wood floor installations, as required;

.6 fully adjustable before and after concrete pour;

.7 knockouts sized from 20 mm (¾") to 50 mm (2") dia;

.8 approximately 334 mm L x 334 mm W x 103 mm D (13-1/8 " x 13-1/8" x 4-1/16");

.9 knockouts sized from 20 mm to 50 mm (3/4" to 2");

.10 tunnelling from compartments as required;

.11 mounting brackets for power receptacles and communication modular devices; note that depth to suit floor slab restrictions as directed by Contract Administrator;

.12 series “FloorPort” activation cover consisting of 197 mm (7-3/4") x 165 mm (6-1/2"), hinged, rectangular, flush access cover opening a full 180 degrees to lie flat on the floor; cover includes two smaller swing open cable egress doors; complete with full sized self-closing recessed handle, trim rings and flooring insert areas; die cast aluminium construction; exact finish and flooring type to be reviewed with Contract Administrator prior to ordering;

.13 series “Evolution” activation cover consisting of 184 mm (7-1/4") diameter, round, flush access cover opening a full 180 degrees to lie flat on the floor; cover includes two smaller slide open cable egress doors; complete with trim rings; die cast aluminum construction; exact finish and floor type to be reviewed with Contract Administrator prior to ordering;

.14 unit designed to prevent water and debris from entering box as per requirements of UL 514A and UL 514 C.

.2 Legrand Wiremold "Evolution" series, CSA approved, ULC listed and labelled, flush floor boxes as follows:

.1 configurable with removable modules and dividers for from 6 to 10 gangs, as required;

.2 versions suitable for installations in concrete, raised floors and wood floors, as required;

.3 2 module wiring compartments with multi-gang capacity for duplex power receptacles and/or communication brackets for telecommunications services;

.4 steel construction;

.5 levelling support legs fully adjustable pre and post concrete pour;

.6 approximately 384 mm L x 284 mm W x 103 mm D (15-1/8 " x 11-3/16" x 4-1/16");

.7 tunnelling from compartments as required;

.8 mounting brackets for power receptacles and communication modular devices;

.9 activation cover consisting of large hinged rectangular access cover opening a full 180 degrees to lie flat on the floor; cover includes two smaller slide open cable egress doors; complete with self-closing recessed handle, trim rings and flooring insert areas; die cast aluminium construction of finish reviewed with Contract Administrator; flooring type to be reviewed with Contract Administrator;

.10 knockouts sized from 20 mm to 50 mm (3/4" to 2");

.11 unit designed to prevent water and debris from entering box as per requirements of UL 514A and UL 514 C.

.3 Finishes to be as approved by The City and reviewed with Contract Administrator.

.4 Refer to drawing details and notes for additional device requirements. Provide power receptacles to standards as specified in wiring devices article. Coordinate telecommunication jack types and installation requirements with telecommunications structured cabling system contractor responsible for work of structured cabling systems. Ensure that brackets are compatible with devices.

.5 Acceptable manufacturers are:

.1 Legrand Wiremold;

.2 Hubbell Canada Inc.;

.3 Thomas & Betts Ltd.;

.4 Wellmark Electric.

3 Execution

3.1 INSTALLATION OF NON-METALLIC SERVICE FLOOR BOXES

.1 Service floor boxes for flush in concrete floor mounting to be concrete tight. Locate into position and install in accordance with manufacturer’s instructions. Coordinate installation with trades pouring concrete floor slab. After concrete has cured, cut off box to required height and install levelling ring.

.2 Prior to start of work, review with Contract Administrator any limitation with regards to size of boxes and floor slab thickness. Do not exceed box dimensions or depth of box limitations reviewed with Contract Administrator.

.3 Do not install non-metallic type boxes in on-grade floor slabs.

.4 Review finishes with Contract Administrator prior to ordering.

.5 Refer to drawings for required service and cover fittings. Install complete with required connection wiring and conduit.

.6 Coordinate data/voice jacks requirements with successful network cabling system contractor of Section entitled Structured Cabling System.

.7 Test and verify devices.

3.2 INSTALLATION OF POKE THROUGH FLOOR ASSEMBLIES

.1 Provide required poke through floor fitting assembly in locations required to feed devices in open floor spaces or through which to extend services. Install and mount assemblies through slab in accordance with manufacturer's instructions.

.2 Prior to start of work, review with Contract Administrator any limitation with regards to core hole diameters and floor slab thickness. Do not exceed hole diameters or depth of box limitations reviewed with Contract Administrator. Core cut suitable openings to accommodate poke though assembly as per manufacturer's instructions and as coordinated with Contractor. Coordinate work with trade chasing or cutting floor slab. Review locations of floor fittings with Contract Administrator prior to coring floors.

.3 Provide suitable fire stopping and smoke seal materials around poke through assembly, to maintain fire rating of surface being penetrated.

.4 Provide service fitting receptacles and outlets as configured in this Specification and/or as shown on drawings. Provide required wiring in conduit and connect complete.

.5 Review finishes and cover inserts where applicable, with Contract Administrator prior to ordering.

.6 For multiple piece fittings, install service floor fitting after any work which may damage fitting.

.7 Run wiring to floor fittings, in ceiling space of floor below. Coordinate work with trade cutting or pouring floor slab.

.8 Coordinate mounting requirements for telecommunication type jacks with trade responsible for provision of respective telecommunication systems.

.9 Ground and bond boxes to local governing electrical code requirements.

.10 Test assembly to verify proper operation.

3.3 INSTALLATION OF FLOOR BOXES AND SERVICE FITTINGS

.1 Prior to start of Work, review with Contract Administrator, conduit runs for each service floor box - whether conduits run within floor slab or connect to boxes through floor slab from floor below.

.2 Provide type of boxes to suit applications as required for on-grade floors, above grade floors, and concrete or wooded floors.

.3 Review finishes and cover inserts where applicable, with Contract Administrator prior to ordering.

.4 Provide flush floor boxes in concrete slab locations. Adjust and level as required. Level flush boxes before concrete pour. Provide conduits to connect to boxes as required.

.5 Do not install non-metallic type boxes in on-grade floor slabs.

.6 Review with Structural Contract Administrator that size of boxes and depth of selected floor boxes is acceptable for installation in floor of installation. Advise Contract Administrator of any concerns.

.7 Where fittings are surface mounted on counters, coordinate installation with trade responsible for counters. Review exact location of openings prior to cutting openings. Install conductors to feed fitting outlets and connect complete.

.8 Provide required outlet fittings and install on recessed boxes. Provide required wiring in conduit and connect complete.

.9 Install products in accordance with manufacturer's requirements. Coordinate work with trade pouring or cutting floor slab.

.10 Coordinate mounting requirements for telecommunication type jacks with trade responsible for provision of respective telecommunication systems.

.11 Ground and bond boxes to local governing electrical code requirements.

.12 Test assembly to verify proper operation.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

1.2 RELATED STANDARDS

.1 Electric vehicle (EV) charging systems to be designed, manufactured and tested according to latest applicable version of following standards:

.1 cUL listed and labelled and CSA approved;

.2 CSA C22.2 No. 280;

.3 CSA C22.2 Nos. 281.1, 281.2 and 282.13;

.4 UL 2594, UL 2231-1, UL-2231-2. UL 1998;

.5 SAE J1772;

.6 FCC: Part 15 Declaration of Conformity and Part 15 Class A.

1.3 QUALITY ASSURANCE

.1 Manufacturer to have produced similar electrical equipment for minimum period of 3 years.

.2 Products to comply with above related standards.

2 Products

2.1 ELECTRIC VEHICLE CHARGING STATIONS

.1 General:

.1 Stations to be based on Level 2 public use electric vehicle charging stations as located on drawings. Refer to drawings for details regarding location of components, mounting requirements, electrical ratings and other required details.

.2 Of bollard and wall mount configurations as noted on drawings.

.3 Two charging ports to share a single circuit, allowing for sites with single port EV stations to upgrade to dual port stations without requiring additional electrical services.

.4 Models with one or two standard SAE J1772 Level 2 charging ports.

.5 For systems online software for system monitor, reporting and billing: each station port to include first year network connection license fee to ChargePoint Software Service Plans to control access, set pricing, display advertising, monitor status and generate usage reports.

.6 System enabled “sticker” feature applied to user security system access control cards to allow users to enable charger stations without having to carry 2 cards.

.7 System does not require Measurement Canada approvals for time of use billing.

.2 LCD Display:

.1 Allows for customizable video.

.2 Daylight readable, with auto brightness control.

.3 Download up to 60 seconds of full-motion, full-colour video to any arbitrary group of stations.

.4 Multiple language support.

.3 Energy Measurement And Management:

.1 Real-time energy measurement.

.2 15 minute interval recording.

.3 Time of day (TOD) pricing.

.4 Load shed by % of running average or to fixed power output.

.4 Cord Management:

.1 Retractable charging cords keep cords off ground.

.2 Ultra-reliable gravity operated mechanism.

.5 Power Sharing: Share one circuit between two parking spaces.

.6 RFID Card Reader:

.1 Multi-format.

.2 Accepts ChargePoint cards, Visa PayWave, MasterCard PayPass, American Express ExpressPay, and Discover Zip contactless credit cards.

.3 Review with The City exact card requirements.

.7 Miscellaneous:

.1 Lamacoid - custom inscribed identification instruction signage with nomenclature as confirmed with The City and reviewed with Contract Administrator.

.2 Head unit either LAN type or Gateway type to suit communications requirements of system confirmed with The City.

.3 Mounting cap, installation hardware and accessories to suit installation requirements of units.

.8 Specifications:

Electrical Input Single	**Port**	**Dual Port**
AC Power Input Rating – Standard	208/240VAC 60Hz single phase @ 30A	208/240VAC 60Hz single phase @ 30 x 2

Electrical Input Single	**Port**	**Dual Port**
AC Power Input Rating – Power Sharing	n/a	208/240 VAC 60Hz single phase @ 32A
Input Power Connections – Standard	One 40A branch circuit	Two independent 40A branch circuits
Input Power Connections – Power Sharing	n/a	One 40A branch circuit
Required Service Panel Breaker – Standard	40A dual pole (non-GFCI type)	40A dual pole (non-GFCI type) x 2
Required Service Panel Breaker – Power Sharing	n/a	40A dual pole (non-GFCI type)
Service Panel GFCI	Do not provide external GFCI as it may conflict with internal GFCI (CCID)	
Wiring – Standard	3-wire (L1, L2, Earth)	5-wire (L1, L1, L2, L2, Earth)
Wiring – Power Sharing	n/a	3-wire (L1, L2, Earth)
Station Power	8W typical (standby), 15W maximum (operation)	

Electrical Output	**Port**	**Dual Port**
AC - Standard	7.0kW (240VAC @ 30A)	7.0kW (240VAC @ 30A) x 2
AC - Power Sharing	n/a	7.0kW (240VAC @ 30A) x 1 Or 3.8kW (240VAC @ 16A) x 2

Functional Interfaces	**Port**	**Dual Port**
Connector(s) Type	SAE J1772™	SAE J1772™ x 2
Charging Cable Length	5.5 m (18’)	5.5 m (18’) x 2
Overhead Cable Management System	Yes	
LCD Display	145 mm (5.7”) full colour, 640x480, 30fps full motion video, active matrix, UV protected	
Card Reader	ISO 15693, 14443, NFC	
Locking Holster	Yes	Yes x 2

Safety and Connectivity Features	
Ground Fault Detection	20mA CCID with auto retry
Open Safety Ground Detection	Continuously monitors presence of safety (green wire) ground connection
Plug-Out Detection	Power terminated per SAE J1772™ specifications
Power Measurement Accuracy	+/- 2% from 2% to full scale (32A)

Power Report/Store Interval	15 minute, aligned to hour
Local Area Network	2.4 GHz Wi-Fi (802.11 b/g/n)
Wide Area Network	3G GSM, 3G CDMA

Safety and Operational Ratings	
Enclosure Rating	Type 3R per UL 50E
Safety Compliance	cUL certified for Canada; UL listed for USA; complies with UL 2594, UL 2231-1, UL 2231-2, and NEC Article 625
Surge Protection	6kV @ 3000A. In geographic areas subject to frequent thunder storms, provide supplemental surge protection at the service panel.
EMC Compliance	FCC Part 15 Class A
Operating Temperature	-30°C to +50°C (-22°F to 122°F)
Operating Humidity	up to 85% @ +50°C (122°F) non-condensing
Non-Operating Humidity	up to 95% @ +50°C (122°F) non-condensing
Terminal Block Temperature Rating	105°C (221°F)
Maximum Charging Stations per 802.11	Radio Group 10. Each station must be located within 45 m (150 feet) “line of sight” of gateway station.

.9 Demonstration and Training: Provide services of manufacturer’s authorized representative to provide start up service and to demonstrate and train The City’s personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance. Minimum 8 hours.

.10 Warranty: Equipment manufacturer to warrant that goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation.

.11 Acceptable Manufacturers:

.1 Acceptable manufacturers include

.1 Flo

.2 Leviton

.2 Other manufacturers may be accepted at discretion of and approval by The City, and subject to following (submit proof with shop drawings):

.1 that system features and performance at least match base specified system;

.2 systems are CSA approved and ULC listed and labelled, as applicable;

.3 system has been installed and operating in other Canadian facilities for at least past three (3) years;

.4 system products and parts are stocked and serviced by Canadian distributor/vendor within Province of install.

3 Execution

3.1 INSTALLATION OF EV CHARGING STATIONS

.1 Obtain required approvals and permits of local governing authorities and electrical inspection authorities.

.2 Installation work to be performed by qualified person familiar and experienced with installation, construction and operation of equipment and hazards involved.

.3 Install per manufacturer's recommendations and contract documents, including drawing notes and details. Comply with requirements of local governing building codes and electrical codes.

.4 Review installation locations and mounting requirements with Contract Administrator prior to roughing-in. Co-ordinate with other trades as required.

.5 Install units plumb, level and rigid without distortion. Secure with required mounting hardware to suit installation application.

.6 General installation of stations to follow procedure in manufacturers' published literature.

.7 Provide required power and communications conductors in conduit and connections. Coordinate communications interconnections with The City's personnel. Connect to dedicated non-GFCI type circuit breaker as per charger manufacturer's directions.

.8 Do not make any changes or modifications to product not authorized by manufacturer.

.9 Interconnect ground with main building grounding.

.10 Provide signage with nomenclature approved by The City and reviewed with Contract Administrator. Secure in locations as reviewed with Contract Administrator.

.11 Coordinate card reader intercommunications with The City security personnel and ACS vendor, as required. Turn over specified cards to Contract Administrator prior to application for Substantial Performance of the Work. Ensure compatibility of products to allow for full integrations as required by The City.

3.2 ADJUSTMENTS AND CLEANING

.1 Remove debris from e electric vehicle charging station and wipe dust and dirt from components.

.2 Repaint marred and scratched surfaces with touch up paint to match original finish.

3.3 TESTING

.1 Check and inspect component connections and overall installation.

.2 Check tightness of accessible mechanical and electrical connections to assure they are torqued to minimum acceptable manufacturer's recommendations.

.3 Check installation for proper grounding, fastening and alignment.

.4 Check communications between equipment and integrated systems, as applicable.

.5 Obtain required approval and certifications of local governing authorities. Submit copies of approvals to Contract Administrator.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section, including but not be limited to following:

.1 engine generator set (genset) with accessories;

.2 genset control panel and related controls;

.3 integration drawings identifying various integration points of other systems of building;

.4 certification that proposed gensets have been prototype tested as fully integrated assembly at vendors factory and is CSA approved.

.2 Include following with shop drawings:

.1 full design detail drawings and layouts;

.2 list of components and accessories;

.3 details of functions and functional relationship of equipment;

.4 information sheets with specifications for equipment; performance data, technical data, EPA rating and details of controls;

.5 system configuration with single-line diagrams;

.6 wiring schematics;

.7 dimensions and weight of set and associated major components;

.8 electrical characteristics;

.9 power and performance data;

.10 fuel consumption data;

.11 point by point description of control system software sequence of operation;

.12 nameplate data identifying electrical characteristics including kW, kVA, V and A ratings, impedances, short circuit withstand rating, etc., as applicable;

.13 list of manufacturer-recommended spare parts, devices and equipment to be provided to The City and to be kept at site in order to minimize risk and to facilitate The City's maintenance program.

.3 Submit operation and maintenance manuals.

.4 Include the following information in the Operation and Maintenance manuals:

.1 Names and address of local suppliers for the items included.

.2 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation.

.3 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature is not acceptable.

.5 Review information provided in the maintenance instructions and manuals with the The Citys' operating personnel to ensure a complete understanding of the electrical equipment and systems and their operation.

1.2 STANDARDS

.1 Gensets and associated equipment to be CSA approved with certificate of compliance, and constructed to and to perform in accordance with following requirements:

.1 C282-15 Emergency Electrical Power Supply for Buildings including maintenance logbook;

.2 Standard Z32-15 Electrical Safety, and Essential Electrical Systems in Health Care Facilities;

.3 CSA C22.1- Canadian Electrical Code, Part I and Manitoba Electrical Code latest Edition;

.4 CSA B149,1-15 Natural Gas and Propane Installation Code;

.5 C22.2 No. 100-04 (R2013) Motors and Generators;

.6 CAN3-C235-83 (R2015) Preferred Voltage Levels for AC systems, 0 to 50,000 V.

.2 Genset manufacturer to be certified to ISO 9001 International Quality Standard and have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.3 TYPICAL DETAILS

.1 Refer to typical details found on drawings for references to products and/or execution required in this Section.

1.4 WARRANTY

.1 Warrant (full 100% parts and labour with no deductible amounts) gensets and control system equipment in writing, to be in strict accordance with Specification and free from defects for 5 year from date of turn over to The City or 1500 operating hours, whichever occurs first. Warranty period starts after acceptance tests and subsequent written acceptance by Contract Administrator and after full connection to building load.

.2 Include for manufacturer/supplier's authorized technician 24 hours around clock service for onsite genset and equipment.

.3 Include with warranty, following:

.1 first year routine maintenance service including parts and labour;

.2 complete oil and filter changes at manufacturer's recommended intervals to maintain warranty validity;

.3 manufacturer's recommended maintenance and servicing to maintain validity of warranty;

1.5 NOISE AND EMISSIONS

.1 Provide genset and work that maintains compliance with levels of noise and air emissions approved by local authorities having jurisdiction.

2 Products

2.1 ENGINE GENERATOR SETS-GENERAL

.1 Engine generator sets (gensets) to be factory assembled and tested, radiator cooled, natural gas engine driven electric gensets including necessary controls and accessories as outlined herein, to comprise a continuous, standby electric generating plant for operation in conditions stipulated below. Gensets to be equipped with necessary operating accessories such as air cleaner, radiator fan, lubricating oil pump, governor, alternating current generator and other specified and required engine driven components and accessories.

.2 Genset manufacturer to be certified to ISO 9001 International Quality Standard and have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

.3 Gensets to include prototype testing as follows:

.1 Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

.2 NFPA 110, Level 1. Equipment engine, skid, cooling system, and alternator to have been subjected to actual prototype tests to validate capability of design under abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.

.4 Base design gensets: genset that complies with specification requirements and drawing requirements, and which may be customized to meet herein specified requirements.

.5 Gensets and associated equipment to be constructed to and to perform in accordance with local governing authority enforced edition of CSA Standard CAN/CSA C282, "Emergency Electrical Power Supply of Buildings". Gensets to be CSA approved type tested in vendor's plant.

.6 Where requirements of preceding standards and specification are in variance, more stringent requirement is to apply unless otherwise approved by The City and reviewed with Contract Administrator.

.7 Gensets and associated equipment to comply with mechanical systems base design parameters (ie. fuel consumption, cooling operating data, air/exhaust operating data, etc.) to ensure that design minimum standards and performance criteria for units are met. Review room/enclosure (as applicable) dimension and layouts and ensure that proposed gensets and associated equipment can be accommodated and also allow for sufficient space for maintenance, repairs, and safety as per applicable code requirements. Advise Contract Administrator of any changes due to manufacturer's changes in equipment, and/or changes in manufacturers. Be fully responsible for provision and co-ordination of a designed solution that can meet design intent, space limitations, and performance requirements with no additional costs to Contract. Co-ordinate changes with Mechanical Division, as required.

.8 Genset driven radiator fan is capable of overcoming a minimum of 0.5" water column pressure drop in an ambient temperature of 50°C (122°F). Review complete air intake and exhaust system design with regards to air restrictions and if required, provide oversized fans with blades of extra strength to overcome additional pressure drop through fresh air intake, discharge silencers, and other related factors, as applicable. Identify clearly on shop drawings that this requirement has been met.

.9 Where eventual supplied genset(s) provides performances that are different from base designed genset, and such differences exist only due to differences in product manufacturers, be responsible for providing required revisions, i.e. increasing sizing of exhaust piping, air dampers, etc. At shop drawing submission stage, submit detailed genset performance data to Mechanical Division Contractor to confirm mechanical equipment sizing and to make necessary revisions. Be responsible for costs for such revisions.

.10 Genset ratings:

.1 Rating of engine generator is as noted on drawings, which is at 0.8 power factor and includes 10% overload.

.2 Rating to be nameplate rating.

.3 Capable of operating at 100% of nameplate rating at rated RPM in an ambient temperature of 50°C (122°F) without overheating, or suffering any other detrimental effects, at rated generator RPM when set is equipped with all necessary operating accessories.

.4 Capable of handling a single full load step for nameplate kilowatt rating within voltage and frequency regulation requirements of CSA 282 without stalling and without voltage dropping below 60% of nominal.

.11 Genset to meet frequency and voltage performance requirements specified in CSA 282.

.12 Gensets and associated equipment to be fully integrated to comprise a standby power system which automatically functions as follows:

.1 start in event of a commercial power failure;

.2 stop when commercial power has been restored;

.3 be capable of operating at light loads for an extended period of time as normal power failure may occur when only part of full output of genset is required.

.13 Moving parts such as flywheels, pulleys, belts, etc., and on hot parts such as manifolds and extending up to and including flexible exhaust pipes, to be enclosed with suitable guards to protect persons from injury. Guards to be easily removable for servicing equipment and are to comply with local governing authority and code requirements.

.14 Genset supplier to obtain torsional approval of entire assembly from engine manufacturer. Align and mount genset on a common fabricated steel base of sufficient rigidity to maintain adequate alignment. Genset manufacturer to supply adjustable steel spring vibration isolators. Include also for seismic restraints to comply with local governing authority and code requirements. Provide torsional vibration analysis and critical vibration analysis of genset and submit results to Contract Administrator.

.15 Genset manufacturer to review engine exhaust system design and confirm in writing that back pressure will not impair operation and output of sets. Forward a copy of confirmation letter to Contract Administrator.

.16 Genset supplier is responsible for but not limited to provide following:

.1 genset(s) and control panels;

.2 enclosure as specified in Section 26 32 05;

.3 system sequence of operation complete with software;

.4 coordination with other trades and systems to ensure proper integration;

.5 exhaust system silencer and ancillary piping and connectors to engine;

.6 genset and full systems demonstration, testing and verification work;

.7 operating and maintenance instructions.

.17 Arrange for genset supplier to review electrical distribution system and ensure that genset grounding provisions are compatible and meet local governing electrical code requirements.

2.2 ENGINES

.1 Engines to be a multi cylinder, 4-cycle, engine capable of operating at a nominal speed of 1800 RPM when directly connected to generator and free from critical vibrations throughout its entire operation range. Engines to operate satisfactorily on natural gas fuel and produce specified rated output.

.2 Engines to be complete with inter changeable cylinder heads, exhaust valves constructed of special alloy steel, and stellite faced exhaust valve inserts. Lubricating systems to be full pressure oiling type through internally mounted, high capacity, positive displacement type gear pumps with adjustable pressure regulators, lubricating oil cooler and full flow oil filters. Full pressure lubrication to be provided to main bearings, connecting rod bearings and camshaft bearings.

.3 Provide drain canisters on air boxes for engines.

.4 Equip engines with an electronic governor with speed control and magnetic pick up assembly capable of maintaining speed and voltage regulation within limits previously specified. Electronic governor to be of type recommended by genset manufacturer to provide performance to suit specific application.

.5 Equip engines with 12/24 volt D.C. electric starting motors, with starting pinion arranged to disengage automatically when respective engine starts.

.6 Equip engines with individual safety devices to shut down engine and to sound an alarm in event of conditions specified later in this Section. Provide contacts to pre-alarm for conditions specified later in this Section. Refer to control panel requirements specified elsewhere in this Section and requirements as detailed on drawings for additional requirements. Provide sensors to connect to electronic controls to monitor and display various engine performance characteristics.

.7 Filters on air intake to engine are of dry vortex type with replaceable elements.

.8 Integral shock isolated mounted emergency lock out stop pushbutton, oil temperature gauge, oil pressure gauge and engine coolant temperature gauge are provided on engine.

.9 Engine mounted accessories are readily removable without dismantling engine alternator, or any other accessories.

2.3 ALTERNATORS

.1 Alternator features include following:

.1 voltage rating as noted on drawings;

.2 drip proof, single bearing and close coupled to engine with an SAE housing;

.3 2/3 pitch;

.4 maximum total harmonic distortion of voltage waveform is not to exceed 6.0% under any given load;

.5 excitation boost not less than three (3) times rated current for 10 seconds;

.6 direct connected brushless exciters; rotating brushless permanent magnet pilot exciter to provide power via automatic voltage regulator to main exciter, and with dynamically balanced rotor permanently aligned to engine by SAE flexible disc coupling;

.7 full amortiseur windings;

.8 windings of Class H rating;

.9 temperature rise not to exceed 130C° as measured by resistance in an ambient temperature 50°C (122°F);

.10 meet or exceed CSA 22.2 No. 100, EEMAC MG 122 and current IEEE Standards;

.11 grounding provisions to suit electrical distribution system.

.2 Extension boxes on alternators to be of sufficient size to accommodate connection cabling and a current sensor for ground fault protection as specified in control panel hereinafter. Connection boxes to be manufactured to isolate cable extending from set and prevent transmission of vibration. Cable is generally as sized on drawings, but in absence of direction, size conductors in coordination with genset supplier to suit application and local governing electrical code requirements.

.3 Voltage regulation systems are to maintain regulation within limits previously specified and include regulator and manual voltage adjustment potentiometer. Regulator to be static voltage regulator with 3 phase sensing, radio suppression module, frequency choke to prevent damage to voltage regulator in case of lower than nominal engine speed, and adjustable stability circuit. Regulator to be as recommended by genset manufacturer.

.4 Equipment is designed to minimize Radio Frequency Interference (RFI) under all operating conditions. "Balanced Telephone Influence Factor" (TIF) is not exceed fifty (50).

.5 Alternator is equipped with Resistor Temperature Detectors (RTD) type thermistors complete with required relays/contacts as required to send trouble signal to control panel. Control panel to monitor warning signal of high temperature of windings.

2.4 ENGINE FUEL SYSTEM

.1 Provide suitable fuel gas pressure regulator, strainers, air/gas control valve, gas pressure monitoring devices with auxiliary contacts, turbo charger, throttle body, gas valve train and rack. Fuel system shall be plumbed to genset skid base for ease of site connections. Exact type/rating/sizing and manufacturers of components to be as recommended by genset vendor to suit specific applications and in compliance with requirements of local governing codes and authorities.

.2 Provide flexible connectors with braided stainless steel covering, diameter to suit engine requirements. For each genset provide two (2) natural gas flexible connectors, diameter to suit engine requirements and minimum 900 mm (36") long.

2.5 JACKET COOLANT HEATERS

.1 Engine jacket coolant heaters to be complete with silicone hoses, immersion type thermostats, pressure switches and ball type-isolating valves on engine water connections. Size of heaters to be sufficient to maintain coolant in engine at genset manufacturer’s rated temperature requirements with unit operating at rated loads and conditions (approximately 6 kW, per engine at 208 V, 1-phase, but confirm with genset vendor and revise to suit).

.2 Jacket heaters to be automatically disconnected when engines are running via oil pressure switches/engine run relay.

.3 Heaters to be KIM "Hotstart" or approved equal, that connect to each engine with high temperature coolant silicone hoses and clamps, specifically used for and approved by governing authorities for such applications.

2.6 COOLING SYSTEM

.1 Cooling system for engines consists of unit mounted air water radiator system with protective screen and a 50% water/50% ethylene glycol coolant solution. Radiator system is equipped with power conductors, control conductors, and ancillary devices as required.

.2 Thermostat maintains coolant temperature at manufacturer’s rated temperature with genset operating at rated load. Size radiator to maintain these conditions and provide complete with high performance static pusher fan, fan motors, radiator core guard, duct adapter flange, mounting frame, expansion tank, thermostatic controls, disconnect switch, a suitable open mesh fan guard and shroud.

.3 Gate drain brass ball valves are provided for draining coolant from each engine block and radiator. Wire braided hoses, piping and fittings to be silicone and are to extend into drain containment pan under genset.

2.7 STARTING SYSTEM

.1 Supply a complete starting system for engine, including:

.1 cranking starter motors;

.2 batteries;

.3 battery heater;

.4 battery stand with insulation board;

.5 battery cable;

.6 battery chargers;

.7 cranking motor cut-out switch (crank for three (3) attempts with intervening periods during a period of no less than 45 seconds and no more than 75 seconds).

.2 Batteries features include:

.1 fully sealed, long life lead acid;

.2 Exide, Delco or Surette with sufficient capacity in an ambient room temperature of 0°C (32°F) to crank each unit at engine manufacturer's recommended cranking starting speed for a period of 60 seconds;

.3 voltage measured at starting motor terminals at end of cranking period specified above, with cranking current flowing, to not be less than 1.75 volts per cell;

.4 sized on basis of engine and battery manufacturer's published data;

.5 type and performance ratings as recommended by genset supplier and approved by The City and reviewed with Contract Administrator to best meet starting requirements of specified genset.

.3 Submit shop drawings and reasons to substantiate choice of batteries.

.4 Batteries to be provided on floor standing, corrosion resistant finished, steel rack, complete with following:

.1 manufacturer's recommended maintenance parts and tools;

.2 jumper cables;

.3 mounting bracket for accessories;

.4 plywood base;

.5 PVC tray.

.5 Battery chargers to be Mechron, Vulcan Electric Ltd. or equivalent as recommended by genset supplier, with features as follows:

.1 remote wall mounting, totally enclosed enclosure;

.2 fully automatic operation;

.3 operating voltage of 115 volt, 60 cycle AC;

.4 AC switch and overload protection isolating voltage ratio transformer, silicon controlled rectifier assembly and DC protection, all suitable for two (2) rates of charging (trickle charge and high rate of charge for use after engine start);

.5 DC ammeter and DC voltmeter gauges, each with 2% accuracy;

.6 AC power "on" indicating light;

.7 AC power failure alarm;

.8 float voltage adjustment;

.9 equalize circuit;

.10 overload protection;

.11 DC output protection;

.12 maximum charge rate to suit application;

.13 necessary contacts for connection of common alarm signal to control system.

.6 Battery chargers to recharge a battery discharged by two cranking cycles (30 seconds each) to 80% of capacity within 4 hours and to full capacity in maximum 12 hours.

2.8 ENGINE GENERATOR MOUNTINGS

.1 Engine flywheel housing to be connected rigidly to generator housing with SAE adaptor. Unit to be mounted on common, heavy duty, stress relieved, fabricated steel baseplate. Obtain torsional approval report of entire assembly from genset manufacturer and submit copies to Contract Administrator. Report to also outline critical speeds of assembly.

.2 Baseplates to be of sufficient rigidity to maintain alignment of engine generator shafts and frames under all conditions during shipping, installation and service and be of all welded construction without bolt on components.

.3 Engine generator feet and baseplate sole plates to be machined parallel and true. Shimming to be of steel type and only be permitted underneath generator feet.

.4 Baseplate to be supported on suitable type vibration isolators meeting specific applications. Isolation efficiency to not be less than 95%. Provide Kinetics or equivalent Korfund type to suit specific application as per genset manufacturer’s recommendations. Typically, isolators to be strategically located in a manner to ensure that each isolator will carry an equal portion of weight and that pressure exerted on structure by each isolator does not exceed 345 kPa (50 psi). Review exact requirements with genset manufacturer and provide vibration isolators and seismic restraints to meet requirements of Specification.

.5 Comply with local governing authority and code requirements with regards to applicable seismic restraints. Provide necessary materials and certification by local authority and submit to Contract Administrator.

2.9 UNIT MOUNTED CONTROL PANELS

.1 Control panels consist of a microprocessor based controller with LCD displays featuring multiple metering displays and graphics, with full options and features as specified herein, and is suitable for operating on system voltage rating noted on drawings, with short circuit capacities to suit maximum short circuit output of alternator.

.2 Controller shall be NFPA 110 and CSA C282 compliant.

.3 Control panel in enclosure is unit mounted on I-beam support base, vibration isolated from genset, and is complete with monitoring devices, meters, indicators, display, and interconnecting/interfacing devices. Digital metering and displays are mounted at eye level. Control panel enclosure is painted with enamel to match genset finish.

.4 Controls and monitoring include but are not be limited to following components:

.1 under frequency/over voltage control module with adjustable relay to trip main breaker on settings of ±12% of normal;

.2 ammeter m ± -1% accuracy;

.3 voltmeter ± 1% accuracy;

.4 power factor meter;

.5 frequency meter ± 1% accuracy;

.6 elapsed time ± 1% accuracy;

.7 engine gauges for oil temperature, oil pressure and engine coolant temperature;

.8 kW meter ± 1% accuracy;

.9 control system to initiate genset starting and stopping sequence, and annunciate any fault condition (local or remote indication); electronic control module monitors and provides digital display of genset functions; an operator interface alpha numeric display provides for viewing of genset data and provides setup, controls and adjustments; a LED bar graph AC data display or approved equivalent is included;

.10 engine selector switch for "OFF AUTO MANUAL" operation; operation of engine in manual position, when selected, bypasses automatic control system and causes an alarm to occur; switch in "OFF" position causes an alarm to occur; switch in either "OFF" or manual position causes amber indicator lamp identifying "NOT IN AUTO" to illuminate when alarm occurs;

.11 alarm horn with silencing button, and an annunciator to flash when any audible alarm is silenced until trouble has been cleared and reset;

.12 miscellaneous controls as shown on drawings and as required including voltage and speed control, emergency stop, fault reset, lamp test, engine start, engine stop and indicating lights;

.13 engine alarm and shut down lamps with signals for conditions specified later in this Section and/or as shown on drawing and as required by local governing authorities having jurisdiction; provide engraved lamacoid identification nameplate for each lamp; provide panel with lamp test button;

.14 required secondary and control wiring, type "TEW" 105°C rated, extra flexible wire with thermoplastic insulation and an overall flame retarding cotton braid, neatly harnessed, suitably secured and identified with slip on identification markers; Wiring to be colour coded to suit application and standards; Note that wiring for DC supply to control panel, wiring for cranking circuits and wiring for air box damper to be minimum number 10 AWG stranded; wiring within control panel to be number 16 AWG stranded; and wiring between control panel and engine generator set and transfer switch to be number 14 AWG stranded; provide separate junction boxes for AC and DC wiring;

.15 ground fault relay to alarm on control panel in event of ground fault on windings of generator; current sensor mounted in generator connection box, and generator leads to pass through zero sequence circuit in connection box ; no internal ground connection in generator is permitted, and annunciator light provided on control panel face to indicate operation of this device; ground fault setting to be determined by genset manufacturer to suit specific application;

.16 current transformers as required of appropriate size for local metering;

.17 current transformers as required for electronic governor;

.18 24 volt DC control system with all fusing centrally located;

.19 required potential transformers;

.20 auxiliary contacts on devices to allow for functions required in controls system and interconnection to integrated systems such as fire alarm and building automation system;

.21 other components as shown on drawings and as required.

.5 Breakers mounted in control panel integral with genset include following features:

.1 moulded case type main breaker: fixed mounted moulded case circuit breaker as required, and where frame size exceeds 225 A, to be complete with solid state adjustable trip unit; in absence of direction, size and ampacity of breaker to be to suit application based on code requirements and genset manufacturer’s recommendations; breaker setting to be such that generator short circuit output will trip breaker; trip unit to include adjustable long, short, instantaneous, time delay and ground fault alarming; exact settings to be determined by genset manufacturer to meet specific applications; exact breaker type to be as recommended by breaker and genset manufacturer to meet such applications and be reviewed with Contract Administrator prior to ordering;

.2 auxiliary automatic breaker (typically 30A-3P, but refer to drawings for exact requirements) to feed damper controls; review exact requirements with Contract Administrator prior to ordering;

.3 refer to drawings for additional requirements.

.6 Electronic controls to monitor various engine performance characteristics including, but not limited to, following:

.1 oil temperature;

.2 timing of engine;

.3 coolant pressure and level;

.4 oil and fuel pressure;

.5 running hours;

.6 air temperature;

.7 battery voltage;

.8 engine overspeed.

.7 Provide controls, contacts and annunciation of shut downs (red) and warnings (amber) alarms for following conditions, conditions as per applicable CSA Standards and conditions as detailed on drawings:

.1 high oil temperature – red;

.2 high oil temperature warning – amber;

.3 high coolant temperature – red;

.4 low oil pressure warning – amber;

.5 low oil pressure – red;

.6 overcrank – red;

.7 overspeed – red;

.8 over voltage – red;

.9 low DC voltage – amber (alarm lamp complete with DC voltage sensor);

.10 cool down period – white;

.11 reverse power – red;

.12 undervoltage – red;

.13 low frequency – red;

.14 high frequency – red;

.15 low coolant level – amber;

.16 low fuel pressure – amber;

.17 gas supply valves isolated – amber;

.18 battery charger failure – amber;

.19 emergency bus alive – blue;

.20 generator bus alive – amber;

.21 ECS not in auto – amber;

.22 low engine temperature – amber;

.23 alarm silence – amber;

.24 alternator winding and bearing high temperature – amber;

.25 ground fault – amber;

.26 genset main breaker open - amber;

.27 automatic transfer switch in non-auto or bypass mode – amber;

.28 combustion air intake damper does not open to 85% after 30 seconds - amber;

.29 air shutdown damper (if applicable) – amber;

.30 ventilation dampers not open – amber;

.31 remote emergency stop station (if provided) – amber;

.32 ancillary building alarms as required;

.33 two spares for future.

.8 Utilize high brilliant cluster type LED’s for indicating lights that are continuously illuminated "ON".

.9 Provide required type of contacts, wiring and connections to auxiliary building systems for applications as noted in Part 3, and for connections to remote annunciators where required.

.10 Provide engraved lamacoid nameplate of each control operator, device and indicating light. Review with Contract Administrator exact nomenclature prior to ordering.

.11 Designer/manufacturer of entire control system is required to:

.1 supply complete design, erection and layout drawings for system, indicating all wiring requirements, interfacing or interconnection provisions required to completely integrate controls with all remote apparatus;

.2 assemble, wire and pre-test system components prior to shipment to site; such tests to be witnessed by Contract Administrator at Contract Administrator’s discretion; defects noted and corrected, and system retested prior to leaving plant;

.3 assist in installation and oversee work to ensure that it meets with requirements;

.4 carry out a site test of system in conjunction with other components in standby power system and demonstrate its power operation to satisfaction of The City and reviewed with Contract Administrator.

2.10 ADDITIONAL ENGINE GENERATOR SET REQUIREMENTS

.1 Provide type of wiring conductors, terminations and ancillary devices, and other requirements necessary to fully install and connect integrated components and accessories. Applications include for power, control, signaling and integration. Confirm exact requirements with genset vendor. Provide fire rated conductors for specific applications of life safety and other similar applications. Products and work to be in accordance with genset vendor's instructions and requirements, requirements of local governing codes and local governing authorities, and applicable CSA Standards.

.2 Nameplates/Labelling:

.1 Provide identification painting, engraved lamacoid nameplates, labelling, and warning signage to The City's requirements and reviewed with Contract Administrator. Identify each component on panels, piping, conduits, etc.

.3 Supply loose with engine generator set, a soldered galvanized steel drip pan to be placed beneath engine to catch any leakage from set.

.4 Supply tools and spare parts required for normal maintenance and adjustment of genset, including:

.1 one complete set of lubricating oil filter elements complete with gaskets;

.2 one complete set of air filters;

.3 two complete sets of spare fuses;

.4 two complete sets of spare lamps for all indicating and warning lights;

.5 one complete set of spare belts;

.6 other manufacturer's recommended spare parts;

.5 Submit sound pressure levels for engine generator set to Contract Administrator, prior to units being shipped to site.

.6 After on-site successful testing, touch up paint genset(s) with manufacturer's supplied paint. Ship loose to site additional one litre of touch up paint for each genset and turn over to The City. Paint control panel with corrosion resistant enamel paint to match genset finish. Review exact finishes with Contract Administrator prior to ordering of paint.

.7 Genset manufacturer/supplier is responsible for factory testing and on-site testing of genset, as specified in Part 3 of this Section.

.8 Include provisions to duct/drain/filter all waste emissions/leaks, to satisfaction of The City and reviewed with Contract Administrator. Under no circumstances are waste emissions or waste fluids to be released into room. Provide proper ducting/piping/filtering.

.9 Components of genset control system and wiring between components functioning as part of this system, to comply with required CSA and local building code requirements with regards to minimum 2-hour fire resistance rating provisions.

2.11 ACCEPTABLE MANUFACTURERS/SUPPLIERS

.1 Selected engine-generator sets to be provided from listed approved genset suppliers and be packaged sets that are factory assembled, factory type tested and warranted together.

.2 Acceptable genset suppliers are:

.1 Cummins Eastern Canada LP;

.2 Toromont Cat. Ltd.;

.3 WAJAX Power;

.4 Rehlko (Kohler)

.3 Acceptable alternator manufacturers are:

.1 Newage Stamford;

.2 Caterpillar;

.3 Marathon;

.4 Leroy Somer;

.5 Rehlko (Kohler)

.4 Acceptable engine manufacturers are:

.1 Cummins;

.2 Caterpillar;

.3 MTU-DDC;

.4 Ford;

.5 General Motors.

.5 Acceptable instrument manufacturers are:

.1 Crompton Instruments;

.2 Basler;

.3 Yoko-gawa.

.6 Main breakers must be of same manufacturer as accepted switchboard supplier of Section entitled Secondary Switchboards to maintain continuity of supply for standardization.

.7 Products to be provided must be CSA approved and labelled, or inspected and approved by Electrical Safety Authority.

3 Execution

3.1 INSTALLATION OF GENSETS AND ENCLOSURES

.1 Provide gensets and enclosures as specified and detailed. Refer to drawing details and notes for additional requirements. Refer to Section 26 32 05 for enclosure requirements and installation requirements. Perform required installation work and coordinate work between trades.

3.2 TESTING REQUIREMENTS FOR GENSETS

.1 Perform factory test of engine generator sets prior to delivery to job site. Include for and arrange for The City and Contract Administrator to witness factory tests and schedule tests at time acceptable to The City and Contract Administrator. Include "out of town" expenses such as transportation, lodging, meals, etc., for The City and Contract Administrator to witness factory testing. Notify The City and Contract Administrator at least two weeks in advance of tests. Should additional tests be required due to failure to comply with conditions specified in this article, costs (all travel expenses, accommodation if required, plus seven hundred and fifty dollars ($750.00) per day) for Contract Administrator to witness these additional tests are to be borne by genset manufacturer/supplier. Genset manufacturer/supplier to be responsible for full arrangements. Tests to include period(s) of minimum 4 hours continuous operation under full load conditions as directed by Contract Administrator. Number of periods of testing to be quantity as required until successful testing of specified requirements to satisfaction of The City and Contract Administrator. Ensure that proper 100% capacity resistive type artificial load banks are available for tests. Factory testing to include use of strip chart recording instruments to confirm that engine generator set complies to all specified requirements in frequency, voltage and current regulation as specified herein this Section. Submit reports for Contract Administrator’s review and obtain The City’s approval prior to shipping gensets to site.

.2 Notify The City and Contract Administrator minimum 2 weeks in advance of onsite testing. Under direction and in presence of The City and Contract Administrator, genset manufacturer’s authorized technician to provide tests at site on genset and associated equipment when installation is complete, but before acceptance of same. Coordinate with independent distribution system testing company to ensure that engine generator set performs with emergency power distribution system in accordance to requirements of all applicable CSA Standards. Refer to and provide additional applicable testing requirements of distribution system testing and coordination study article.

.3 Coordinate and arrange for manufacturer’s trained mechanic to conduct such tests and to make all required changes and adjustments found necessary by such tests. Repeat tests until all defects are corrected and equipment operates properly to Contract Administrator’s satisfaction. Perform general operational testing and other testing as per CSA Standards and requirements herein specified. Perform full load test, which is to include period(s) of minimum 4 hours continuous operation under full load conditions as reviewed with Contract Administrator. Number of periods of testing to be as required to successfully demonstrate that genset and associated equipment complies with specified parameters to satisfaction of The City and reviewed with Contract Administrator. Perform initial testing with load banks. Perform testing with building loads when approved by The City and reviewed with Contract Administrator.

.4 On site testing to be performed at times acceptable to The City and reviewed with Contract Administrator. Be responsible for costs of additional testing due to failure of genset to perform to specified standards, with additional expenses in effect as specified previously for factory testing. Supply variable load banks and connecting cables, sized for 100% capacity of plant, for testing procedure indicated herein.

.5 Include for license electrician to be on site for testing, verification and commissioning Work, to make any required distribution system changes necessitated by Work. Arrange for genset supplier's controls contractor to be present for testing and commissioning.

.6 Upon completion of installation of equipment, by Contractor, equipment manufacturers to inspect installation of each complete equipment assembly and certify in writing satisfactory installation and operations of same, to The City. Submit detailed list of deficiencies to Contract Administrator.

.7 Equipment manufacturers to include for site visit to inspect, test, perform start-up, and verify installation to ensure that installation and Contractor is in compliance with Contract Documents.

.8 Upon acceptance of genset power plant, arrange for manufacturer's technician to instruct The City's operating personnel in correct operation and maintenance of plant. Provide DVD recording of such instruction.

.9 Perform test procedures in accordance with test sheets found at end of this Section. Submit reports signed and bound to Contract Administrator using these typical sheets.

.10 Following are general typical guidelines for testing of gensets and controls. Review exact requirements with Contract Administrator and Commissioning Agent prior to start of Work. Additionally, contact genset manufacturer and obtain their recommended testing procedures for specific gensets of this Project. Coordinate with genset supplier.

.11 Operational Tests:

.1 With engine in a "cold start" condition and emergency load at its normal operating level, simulate a power failure by means acceptable to Contract Administrator. Do not interrupt existing services unless approved in writing by The City and reviewed with Contract Administrator. Test load to be load which is normally served by emergency power system. Unless instructed by or approved in writing by The City and reviewed with Contract Administrator, do not use building loads for testing. Provide variable load banks sized for loads as required.

.2 Continue operational test for 1 hour, after which time, restore normal power and demonstrate satisfactory transfer of load and shutdown of emergency generating sets.

.3 Observe and record following:

.1 time delay on start;

.2 cranking time until engine starts and runs;

.3 time required to come up to operating speed;

.4 time required to achieve a steady-state condition with all transfer switches transferred to emergency position;

.5 voltage, frequency, and amperes at start-up and at any observed change in load;

.6 engine oil pressure, water temperature where applicable, and battery change rate at 5 min intervals for first 15 minutes and at 15 minute intervals thereafter;

.7 time delay on retransfer for each transfer switch;

.8 time delay on engine cool down and shutdown;

.9 check and test operation of engine starting system, and jacket coolant heaters.

.4 Full Load Test:

.1 Following operational test, subject genset to a 4 hour 100% load test.

.2 Provide variable load bank for testing, unless use of building load is permitted in writing by The City and reviewed with Contract Administrator.

.3 Full load test may be initiated by any method that will start engine and, immediately upon reaching its rated speed, pick up full load in one step.

.4 Record data for items listed above, at first load acceptance and every 15 minutes thereafter until completion of test period.

.5 Cycle Crank Test:

.1 Prevent engine from running by utilizing any method recommended by manufacturer. Place control switch in "run" position to cause engine to crank.

.2 Engage engine starting system to provide a cranking cycle consisting of:

.1 30 seconds of continuous cranking; or

.2 three (3) 10 seconds crank attempts separated by 10 seconds rest periods;

.3 repeat crank cycle a second time to demonstrate that batteries have sufficient capacity for a total cranking time of 60 seconds;

.4 demonstrate time required to recharge batteries to meet requirements.

.6 Safety Shutdown and Alarms:

.1 Test gensets as recommended by manufacturer and as described herein this Section to ensure that safety shutdowns and alarms are fully functional.

.7 Ventilation:

.1 During testing of gensets, demonstrate that sufficient ventilation is provided for room/enclosure housing gensets, in accordance with requirements of CAN/CSA-C282.

.8 Voltage and Frequency:

.1 Perform this test in accordance to CAN/CSA-C282.

.9 Oil Analysis:

.1 Perform this test in accordance to CAN/CSA-C282.

.10 Exhaust System:

.1 Coordinate with Mechanical Division as applicable, to perform required testing to show that performance of integrated engine with exhaust system and stack complies with Specification.

.11 Final Testing:

.1 Upon approval of The City, perform final load testing similar to requirements specified above but with building load connected. Notify The City in writing, minimum 3 weeks prior to proposed testing and obtain permission. Final testing to be performed during non-regular business hours as approved by The City.

3.3 TESTING, START-UP, VERIFICATION AND TRAINING

.1 Assist installing Contractor in installation of equipment and to inspect installation, test equipment, perform start-up and verify equipment. Coordinate work with Contractor.

.2 Be present to assist during third party testing and commissioning.

.3 Perform testing at times reviewed with Contract Administrator.

.4 Provide instructions on system operating and maintenance.

END OF SECTION

APPENDIX: ENGINE-GENERATOR TEST REPORT

PROJECT: _____ Project No: _____

_____ Date: _____

_____

OWNER: _____

CONTRACT ADMINISTRATOR: _____

CONSULTING ENGINEERS: AECOM

LOCATION: _____

_____

PRESENT: _____

_____

_____

ENGINE DATA: _____ SERIAL NUMBER: _____

_____

_____

A. UNIT – GENERAL

B. CONTROL PANEL – GENERAL

C. VIBRATION CONTROL

D. START-UP TIME

COLD UNIT: _____

HOT UNIT: _____

E. SAFETY DEVICES AND TIME DELAY OPERATION

SHUT-DOWN OPERATION	ALARM	BELL	LIGHT
LOW OIL PRESSURE			
HIGH COOLANT TEMP.			
OVERSPEED			
OVERCRANK			
OTHERS			
SHUT-DOWN TIME DELAY	4 MIN. AFTER NORMAL POWER RESTORED		

F. HOUR METER READINGS

START: _____

CONCLUSION: _____

G. RECORDING INSTRUMENTS (SPEED OF CHART)

1. VOLTAGE (REGULATOR)
   - ALLOWABLE VARIATION: _____
   - ACTUAL VARIATION @ 0-1/4 LOAD = _____
   - ACTUAL VARIATION @ 0-1/2 LOAD = _____
   - ACTUAL VARIATION @ 0-3/4 LOAD = _____
   - ACTUAL VARIATION @ 0-1/1 LOAD = _____

2. FREQUENCY (GOVERNOR)
   - ALLOWABLE VARIATION: _____
   - ACTUAL VARIATION @ 0-1/4 LOAD = _____
   - ACTUAL VARIATION @ 0-1/2 LOAD = _____
   - ACTUAL VARIATION @ 0-3/4 LOAD = _____
   - ACTUAL VARIATION @ 0-1/1 LOAD = _____

3. RECOVERY TIME _____

H. VOLTAGE ADJUSTMENT (SPECIFY):

I. EXHAUST PRESSURE:

J. GENERAL OBSERVATIONS:

K. INCOMPLETE ITEMS AND/OR DEFICIENCIES:

L. METHOD OF LOADING (SPECIFY):

TIME IN MINUTES:	
LOADING	
AMPS – PHASE 1	
AMPS – PHASE 2	
AMPS – PHASE 3	
VOLTS – PHASE 1	
VOLTS – PHASE 2	
VOLTS – PHASE 3	
FREQUENCY (HZ)	
OIL PRESS. (PSI)	
OIL TEMP. (°C)	
WATER IN TEMP. (°C)	
WATER OUT TEMP. (°C)	
JACKET TEMP. (°C)	
EXHAUST. TEMP. (°C)	
ENGINE SPEED (RPM.)	
CHARGER	
POWER FACTOR	
GENERATOR TEMP. (°C)	
ROOM TEMP. (°C)	
EXHAUST SMOKE	
KW. RATING	
VACUUM (GAS UNITS ONLY)	

AECOM

Date: _____ Per: _____

END OF APPENDIX

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section, including but not limited to following:

.1 genset enclosure;

.2 enclosure accessories and components;

.2 Shop drawings to include following:

.1 full design detail drawings;

.2 layouts and dimensions;

.3 equipment capacities;

.4 wiring schematics;

.5 integrated systems.

1.2 TYPICAL DETAILS

.1 Refer to typical details found on drawings for references to products and/or execution required in this Section.

1.3 WARRANTY

.1 Warrant (full parts and labour) entire genset enclosure and accessories, in writing, to be in strict accordance with Specification and free from defects for minimum five (5) years from date of site performance and acceptance test and subsequent written acceptance by Contract Administrator or 1500 operating hours, whichever occurs first.

.2 Above warranty requirements and issues to be provided by genset manufacturer or manufacturer’s authorized genset supplier.

2 Products

2.1 GENSET ENCLOSURE (SKIN-TIGHT)

.1 "Skin-tight" type genset enclosure to be provided to house genset complete with silencers, control panel, batteries and accessories. General features include but are not limited to following:

.1 outdoor, weatherproof, corrosion resistant;

.2 sound attenuated;

.3 non-combustible fire-rated construction designed to required local governing authority and code requirements;

.4 heavy duty aluminium or steel outer skin over heavy-duty steel framework construction and primed and finished with corrosion resistant paint finish;

.5 sound insulated panels;

.6 exhaust silencer;

.7 dry type distribution transformer and breaker panelboard, sized to accommodate loads of enclosure components requiring power feeds; factory prewired breaker panelboard to be 120/208 VAC with main breaker and branch breakers for feeding genset and enclosure components and accessories; include three (3) additional spare 15A-1P breakers installed in panel;

.8 locking access panels;

.9 flexible coolant and lubricating oil drain lines, that extend to exterior of enclosure, with internal drain valves;

.10 external radiator fill provision;

.11 radiator guard;

.12 heavy duty steel beam mounting base;

.13 insulated ventilation louvers and dampers;

.14 insulated enclosure with non-hydroscopic materials;

.15 pitched roof, such that precipitation falling on roof does not drain over access doors;

.16 corrosion resistant stainless-steel door hardware, hinges and locks;

.17 locking compartments for storage of manuals, spare parts and tools;

.18 warning signs;

.19 vandal proof construction;

.20 finish painted in colour as approved by The City and reviewed with Contract Administrator;

.21 minimum one GFI duplex receptacle located inside enclosure on each side, and weatherproof GFI receptacle on outside of enclosure;

.22 switches controlling AC powered LED lamps mounted in vapour tight and gasketed internal fixtures; also controlled with 60 minutes adjustable timer;

.23 switched controlled vapour tight, gasketed DC light connected to main batteries; also controlled with 60 minutes adjustable timer;

.24 external AC weatherproof and vandal proof LED type fixture with photocell control over panel access door;

.25 thermostatically controlled forced air internal heater to keep interior temperature at minimum temperature as per CSA C282;

.26 exhaust fan for internal high temperature heat removal from enclosure and include modulating thermostat control;

.27 emergency power off (EPO) station consisting of minimum 38 mm (1-1/2") diameter mushroom head, mounted in weatherproof enclosure with break glass cover for emergency access and locking operator for authorized access; typically mount recessed or semi-recessed in exterior wall of enclosure at each walk-in door; lock operator to be keyed to The City's requirements; provide "EMERGENCY POWER OFF" identification lettering; review exact nomenclature with Contract Administrator prior to ordering;

.28 storage cabinet for operating and maintenance manuals and spare parts;

.29 seismic restraints as required by local governing building code;

.30 in applications of use of dissimilar materials, include provisions to prevent corrosion.

.31 Interior lighting with battery back up power to suit CSA C282 requirements.

.2 Enclosure to meet applicable codes and standards enforced by local governing authorities, including but not limited to:

.1 CSA C282;

.2 ULC Standards;

.3 National Fire Protection Association (NFPA);

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA);

.5 American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE);

.6 local applicable building codes;

.7 local applicable electrical codes;

.8 Manitoba installation code for oil-burning equipment;

.9 Technical Standards and Safety Authority (TSSA).

.3 Enclosure assembly to be designed such that genset components needing routine maintenance and servicing or replacement are easily accessible from access doors. Access doors to be locking, hinged type with retainers to hold doors open during service. Rooftop enclosures with fuel tanks to include access doors/panels sized to accommodate passage of fuel tanks.

.4 Intake and exhaust louvers to be located at height to minimize effects from flood waters and accumulated snow levels. No roof penetrations except for exhaust stack.

.5 Provide motorized intake louvers to minimize air flow through enclosure when generator set is not operating. Louvers to include provisions to prevent accumulation of ice or snow that might prevent operation. Louvers to be spring open, power close operation, as per governing local authority and code requirements.

.6 Enclosures to include weatherproof cable stub and openings for connection cabling through underside of base. Provide load bank cabling entry and temporary genset connections via openings with flexible boots behind a gasketed locking hinged door. Boots to prevent egress of any precipitation into enclosure when cables are run into enclosure. Exterior components and parts to be corrosion resistant and weatherproof. Coordinate location of cable access openings to suit structural base. Provide cable connection box with copper bussing.

.7 Sound-attenuated housing rated to allow generator set to operate at full rated load in an ambient temperature of up to 40°C (104°F).

.8 Acoustics:

.1 Maximum permissible sound emissions criteria for enclosure at engine full load rating to be net 72 dBA at 7m (23') including provisions for reverberations from neighbouring walls.

.2 Selection of silencer (muffler) to be coordinated with design of enclosure to meet sound level requirements.

.3 Submit with shop drawings, certification letter from a recognized acoustical authority certifying factory testing acoustical performance of enclosure housed genset, with genset operating at full load rating in accordance with specification requirements.

.4 Include for a qualified acoustical engineer to perform an acoustical field test during onsite genset testing, to certify performance and provide documented test report. Measure noise levels at 10 different locations as reviewed with Contract Administrator.

.5 Obtain and submit required approvals from local governing authorities having jurisdiction.

.6 Materials of construction to be to general accepted trade standards unless more stringent requirements are required by any recent codes or regulations by local governing authorities. Ensure that most recent applicable standards are met.

.9 Provide complete grounding and bonding conductor system in compliance with code requirements, complete with conductors from equipment and exterior ground rods or for connection to main building grounding system. Refer to Section entitled Grounding and Bonding for additional grounding and bonding requirements.

.10 Engine exhaust system features are as follows:

.1 Engine exhaust system to be full factory installed within enclosure and consists of lengths of flexible stainless-steel exhaust pipe, flange, mounting brackets, and exhaust silencers with drain plug and other required accessories. Size length of flexible piping for thermal expansion and engine vibration and to suit enclosure height restriction. Final selection to suit respective size of genset and to be coordinated with enclosure design to suit spacing and overall noise criteria. Both flexible pipe and silencer to be suitable in all respects for application and be as recommended by genset supplier. Acceptable manufacturers of silencers are SMS, Vibron Ltd., Nelson, and Maxim.

.2 Custom manufacturer heavy duty steel exhaust flange to extend from silencer to roof thimble. Exhaust system exhausts out of enclosure roof through an insulated roof thimble designed for application and with weatherproof sealed pre-fabricated flashed roof curb. Thimble to be of heavy duty galvanized steel corrosion resistant construction.

.3 Terminate exhaust pipe flange minimum 450 mm (18") above roof line and top with required temporary weatherproof cap. Exhaust stack stub assembly to be capable of supporting an on-site installation of a vertical exhaust stack up to 10' (3m) high. Provide guy wires as required for proper support. Interior exhaust piping to be insulated with minimum 50 mm (2") thick Rockwool type insulation suitable for application. Exact height of exhaust stack to suit MOE Certificate of Air and Noise Approval criteria coordinated with noise and emissions Contract Administrator and drawing requirements.

.4 Exhaust stack and piping to meet requirements of local governing technical standards and safety authority standards and other required governing authorities. Exterior vertical exhaust stack to be constructed of minimum schedule 40 rigid black steel, or double wall construction stainless steel chimneys as manufactured by Selkirk or Van-Packer. Diameter to suit genset sizing as noted and confirmed with genset manufacturer. Exhaust stack to extend to height reviewed with Contract Administrator. Stack design and layout to prevent ingress of water/snow back into silencer and means reviewed with Contract Administrator to drain any accumulation in exhaust piping away from enclosure. Stack in position to be designed to withstand anticipated wind forces and other forces of nature. Provide required supports and/or guy wiring as per stack manufacturers recommendations as coordinated with genset vendor.

.5 Coordinate routing, dimensions, and configuration of exhaust system with enclosure dimension restrictions and equipment layout as detailed and as noted.

.6 Ensure that exhaust stack is positioned in location such that emissions do not become drawn into enclosure during operation. Weatherproof and seal openings in roof due to exhaust stack work.

.7 Where required to suit exhaust configuration of respective gensets, provide properly sized black steel pipe welded "Y" connector.

.11 Fire Alarm System Provisions:

.1 Enclosure to include provisions of empty conduits with fish cord and boxes for installation of future detectors and associated fire alarm devices provided by main building fire alarm vendor. Coordinate work with fire alarm vendor. Fire alarm device conduit runs to allow for Class A looped running of system wiring, extending from device boxes to termination box near enclosure wall easily accessible by Contractor for extension to main building. Provide separate conduit loop runs for each of initiating devices and for indicating devices. Coordinate work with respective vendors.

.2 Provide fire extinguishers of CO2 type, minimum 10 pounds (4.5 kg), and mounted within enclosure. Exact type of fire extinguisher to be as recommended by genset vendor to suit application. Provide mounting bracket and install on interior wall adjacent door. Include identification label on outside of door identifying location of extinguisher.

.12 Access and Security Signs, and Nameplates/Labeling:

.1 Provide identification painting, engraved lamacoid nameplates, labelling, warning signage and access and security signage to The City's requirements. Identify each component on panels, piping, conduits, etc.

.2 Provide ULC listed labels clearly identified for components and in locations to approval of local governing authorities and TSSA.

.3 Provide signage as follows:

.1 corrosion resistant, weatherproof and resistant to fading from sunshine;

.2 red lettering on white background;

.3 be permanently affixed;

.4 nomenclature to be reviewed with Contract Administrator prior to manufacturer, but generally to read as follows:

.1 exterior: "AUTHORIZED PERSONNEL ONLY";

.2 above genset: "WARNING – KEEP OFF – GENSET MAY START AUTOMATICALLY AT ANY MOMENT".

.13 Testing, Start-up, Verification and Training:

.1 Perform standard factory testing as integrated with factory witness testing of gensets specified in respective genset Sections. Test equipment and systems and verify proper operation. Document testing and results in reports signed by genset enclosure manufacturer's authorized technician. Submit copies of report to Contract Administrator.

.2 Onsite after installation inspection, testing, start-up, and verification to be integrated with genset testing, start-up, and verification work as specified in respective genset Sections. Assist installing Contractor in installation of equipment and to inspect installation, test equipment, perform start-up and verify equipment. Coordinate work with Contractor. Document testing and results in reports signed by genset enclosure manufacturer's authorized technician. Submit copies of report to Contract Administrator.

.3 Be present to assist during onsite third-party testing and commissioning.

.4 Perform testing on dates and at times reviewed with Contract Administrator.

.5 Provide instructions on system operating and maintenance.

.14 Acceptable enclosure manufacturers are as recommended by genset vendors/suppliers.

3 Execution

3.1 INSTALLATION OF GENSET AND ENCLOSURES

.1 Provide genset and enclosure as specified and detailed. Refer to respective genset section for genset requirements.

.2 Prepare and submit with shop drawings, necessary design, erection and layout drawings, wiring, piping and control diagrams as required for proper execution and completion of Work.

.3 Coordinate controls work both at factory and on site and include for required interface work to equipment on site.

.4 Manufacturer/supplier to upon successful factory witness testing of unit, arrange and coordinate delivery and transporting of unit to site.

.5 Perform testing, start-up and verification work as specified herein and in respective genset section.

.6 Provide transporting and hoisting of gensets and enclosures as required to locate into position. Coordinate responsibility and requirements with General Trades Contractor.

.7 Provide components and installation in factory as required.

.8 Install galvanized steel drip pan under each engine.

.9 Fill radiator with a solution of 50% clean water and 50% permanent type ethylene glycol (exact ratio to be confirmed with genset manufacturer). Check specific gravity of engine coolant. Add glycol and/or water if required.

.10 Check level of engine lubricating oil and add if required. Check and test operation of engine starting system, and jacket coolant heaters. Include acoustical testing to verify sound levels during operation at full load.

.11 Make conduit connections to generator set with liquid tight flexible conduits.

.12 Provide exhaust stack extension and mount to enclosure as per genset supplier’s instructions. Secure as required.

.13 Connect and ground unit with proper copper ground conductors. Ground and bond equipment as per local electrical code requirements.

.14 Refer to and provide additional applicable testing requirements of distribution system testing and coordination study article.

.15 Provide control panel wiring provisions to fire alarm system, and if necessary, provide required low voltage relays, wiring and contactors from generator control panel to fire alarm system control panel for supervision and annunciation of "Main Breaker Open", "Generator Running", "Generator Failure to Start", "Low Voltage Generator Battery" and "Low Fuel Level/Pressure". Include additional points as required by local governing authorities and codes. Provide provisions for points to BAS and fire alarm system.

.16 Seal enclosure openings for cables, piping, conduits and other penetrations after installation, with water tight fire stopping and smoke seal materials.

.17 Test and verify functions of enclosure with genset testing.

.18 Obtain local governing technical standards and safety authority and other required local governing authority approvals and certifications.

.19 Additionally, refer to testing, coordination and verification requirements in respective genset section and include applicable requirements.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

2 Products

2.1 UNINTERRUPTIBLE POWER SUPPLY (UPS) UNITS

.1 Eaton, CSA approved and ULC listed, 93PM series continuous duty, on line uninterruptible power supplies, as specified in following paragraphs and as noted on drawings.

.2 General Features:

.1 Modular construction, with draw-out assemblies that can be quickly serviced or replaced as necessary.

.2 Double conversion topology.

.3 Scalable configurations on larger capacity units, of up to 4 identical modules paralleled allowing additional capacity to total rated kVA of unit or for redundancy, as noted.

.4 Each paralleled unit operates with its own battery string.

.5 Monitoring and control components provides self-diagnosis and self-correction where upon sensing a problem, automatically transfers unit to bypass and when alarm condition clears, automatically reverts back to normal power.

.6 Microprocessor controlled logic.

.7 EMI suppression; surge, spike and continuous brownout protection.

.8 Internal maintenance bypass.

.9 External maintenance bypass with matching cabinet.

.10 Internal battery pack to provide specified battery time at full capacity load.

.11 Battery monitoring of lifetime conditions, runtime remaining and battery temperature.

.12 Battery circuit testing.

.13 Communication interfaces.

.14 Cabinet enclosures.

.15 100% front accessible.

.16 Required ancillary devices.

.3 Applicable Standards:

.1 UPS unit to meet requirements of latest editions of applicable Standards including:

.1 CSA C22.2 107.1;

.2 ULC listings;

.3 IEEE 587/ANSI C62.41 Standards;

.4 FCC Rules and Regulations.

.4 Performance Ratings:

.1 Output Power Capacity: Exact capacity as noted on drawings.

.2 Input and Output Voltage Ratings: As noted on drawings.

.3 Minimum 97% efficiency full load at unity power factor.

.4 Input and output voltages as noted on drawings.

.5 Input Power Factor: 0.99 min.

.6 Input Voltage Range: +10% to -10%.

.7 Input FREQUENCY RANGE: 40 to 72 Hz.

.8 Input Current Distortion: Less than 3% without input filter.

.9 Output Voltage Regulation: +/-1% from nominal output voltage for any steady state operating condition.

.10 Output voltage THD: Less than 1.5% maximum typical non-linear load.

.11 Overload current capability (with nominal line and fully charged battery, non-paralleled systems):

.1 Double Conversion Mode: maintains voltage regulation for 102% to <110% of resistive/inductive load for 10 minutes, 111% to <125% for 60 seconds, and 126% to 150% for 10 seconds, >151% for 300 ms.

.2 Stored Energy Mode (typically on battery): maintains voltage regulation for 102% to <110% of resistive/inductive load for 10 minutes, 111% to <125% for 60 seconds, and >126% for 300 ms.

.3 On Bypass (single UPS systems): Continuous = 125%; Transient = 1000% peak current for 10 ms.

.12 Common mode noise attenuation:

.1 -65 dB up to 20 kHz, -40 db up to 100 kHz.

.2 > 100 dB with isolation transformer.

.13 EMI Suppression: meets FCC rules and regulation 47, part 15, for Class A devices, CISPR22, and IEC62040-2 C2 and C3.

.14 Electrostatic Discharge: meets IEC61000-4-2 level 3; 4 kV contact/8 kV air discharge.

.15 Operating Temperature: 5°C to +40°C (+41°F to +104°F) without derating.

.16 Storage Temperature: -25°C to 55°C (-13°F to 131°F).

.17 Relative Humidity: 5 to 95%.

.18 Altitude: 1000 m (3,300') without derating.

.19 Audible noise: Less than 65 dBA at 1 m (3') from any operator surface.

.5 UPS Module Modes of Operation: UPS Modules operate as on-line, fully automatic system in following modes:

.1 Normal: Utilizing commercial AC power, critical load continuously supplied by inverter which powers load while regulating both voltage and frequency. Rectifier derives power from commercial AC source and supplies DC power to inverter. Simultaneously, battery charger charges battery.

.2 Battery: Upon failure of commercial AC power, critical load continues to be supplied by inverter, which obtains power from batteries without any operator intervention. There is no interruption to critical load upon failure or restoration of commercial AC source.

.3 Recharge: Upon restoration of AC source, charger recharges batteries and simultaneously, rectifier provides power to inverter. This is automatic function and causes no interruption to critical load.

.4 Bypass: If UPS module is taken out of Normal mode for overload, load fault, or internal failures, static bypass switch automatically transfers critical load to commercial AC power. Return from Bypass mode to Normal mode of operation is automatic. No-break transfer to and from Bypass mode is capable of being initiated manually from front panel.

.5 Energy Saver (or equivalent): UPS continuously monitor voltage and frequency of bypass source. When source parameters are within acceptable limits, UPS utilizes minimal/optimal combination of its internal subsystems to ensure acceptable power is always delivered to critical load, at a system efficiency of up to 99%. Energy Saver System is enabled and adjustable by user. System also provides maximum power conditioning any time bypass source variation levels exceed preset, adjustable limits. System is able to distinguish between upstream (utility) faults and downstream (load) faults, and react appropriately to protect and support critical load, without interruption.

.6 Universal Power Modules: Each module contains:

.1 Rectifier/Charger:

.1 Converts incoming AC power to regulated DC output for supplying inverter and for charging battery.

.2 High-frequency pulse-width-modulation (PWM) design, using Insulated Gate Bi-polar Transistors (IGBTs).

.3 Modular design for easy replacement.

.4 Rectifier capable of drawing power from utility with a power factor of 0.99 under nominal conditions.

.5 Rectifier protection circuitry prevents IGBTs from sourcing current in excess of their published ratings.

.2 Inverter:

.1 Inverter is IGBT PWM design with high speed switching.

.2 Provides specified quality output power while operating from any DC source voltage (rectifier or battery) within specified DC operating range.

.3 Protection circuitry that prevents IGBTs from sourcing current in excess of their published ratings.

.7 Static Bypass:

.1 Alternative source of power for critical load when abnormal condition prevents operation in normal mode.

.2 Fully rated, continuous duty, naturally commutated static switch for high-speed transfers.

.3 Transfers to bypass (for stand alone, and parallel capacity systems) automatically initiated for following conditions:

.1 output overload period expired;

.2 critical bus voltage out of limits;

.3 internal over temperature period expired;

.4 total battery discharge;

.5 UPS failure.

.4 Uninterrupted automatic re-transfer occurs whenever inverter(s) can assume critical load.

.5 Uninterrupted automatic re-transfers are inhibited for following conditions:

.1 when transfer to bypass is activated manually or remotely;

.2 in event of multiple transfers/re-transfer operations control circuitry limits "cycling" to three operations in any ten-minute period; third transfer locks critical load on bypass source, for 60 minutes;

.3 UPS failure.

.6 Uninterrupted manual transfers are initiated from control panel, and transfers to bypass and from bypass is possible with inverter logic. During manual transfers to bypass mode, inverter must verify proper bypass operations before transferring critical load to bypass.

.7 Transfers to bypass are inhibited for following conditions:

.1 bypass voltage out of limits (+10%, to -10% of nominal);

.2 bypass frequency out of limits (+/- 4 Hz, adjustable, factory set);

.3 bypass out of synchronization;

.4 bypass phase rotation / installation error.

.8 Static transfer time: No break, complete in less than 4 ms.

.9 Bypass manually energized using control panel or remotely through building alarm input.

.8 Monitoring and Control Components:

.1 Control panel provides fully automatic operation of through microprocessor controlled digital signal processing. Start-up and transfers are automatic functions, and do not require operator intervention.

.2 System software to provide control, monitoring and communication requirements of UPS unit and batteries. System software to be compatible for use by wide range of operating systems.

.3 178 mm (7") touch sensitive, backlit LCD front panel display that includes LED indicators for basic UPS status. Colour coded LED vertical bars show UPS status (green, amber, red).

.4 LCD Displays:

.1 UPS status (home screen): shows UPS status output voltage and battery time remaining, load level, average efficiency, power consumption in kWh, system mimic diagram, operating mode, and active events.

.2 Controls Tab: touch sensitive button controls, for turning UPS on and off, transfer to/from bypass, enabling or disabling battery charger, initiating battery test, and enabling or disabling Energy Saver System.

.3 Metering Tab: screen shows voltages currents, temperatures, kW, kVA, and power factor (as applicable) for UPS input, output, bypass source, and battery; colour coded (green, amber, red) bar graph indicators accompany power and temperature measurements.

.4 Logs Tab: alarm/event queue, active alarms and alarm history, events, status changes and commands, all timed to 1/1000th second for tracking and analysis;

.5 Statistics Tab: Numerically and graphically displays estimated savings afforded by energy saver operation over time.

.6 Settings Tab: Button access to user adjustable settings such as, but not limited to: date/time, building alarm designations, communications parameter setup, UPS name, user passwords, and display language.

.5 Control Panel Lamp Indicators:

.1 NORMAL: Green LED indicates that commercial AC utility or generator source is supplying power to rectifier and inverter is supporting critical load.

.2 BYPASS: Amber LED indicates that UPS has transferred load to bypass circuit.

.3 BATTERY: Amber LED indicates that commercial AC utility or generator source has failed and battery is supplying power to inverter, which is supporting load.

.4 ALARM: Red LED and accompanying audible alarm horn, indicates that UPS detects an alarm condition, outlined in detail in Logs tab from home screen and in operator's manual.

.6 Interface Panel: Provides following signals and communication features:

.1 Alarm Contact: Dry contact for annunciating summary alarm for user use.

.2 RS232 (EIA / TIA-232) and USB communications interfaces.

.3 Building Alarms: Five Inputs for monitoring status of external dry contacts.

.4 External REPO Contacts: To connect an external remote emergency power off switch to shut down UPS and de-energize critical load.

.5 Battery Control Contacts: To connect battery shunt trip and auxiliary contact signals from battery breaker or battery disconnect switch.

.6 External Bypass Indicator Connection: To acknowledge that external maintenance bypass has been closed around UPS, placing critical load on utility power.

.7 Communications: UPS to be equipped with field configurable communications to allow for remote monitoring functions via plug-in devices. Include for:

.1 Remote Monitoring:

.1 WEB/SNMP communication.

.2 Communications devices capable of communicating via various industry standard protocols such as RS232, SNMP, BACnet and ModBus.

.3 Monitoring of UPS status through isolated dry contact Form C relays; include minimum 2 NC and 2 NO contacts for auxiliary functions.

.4 Relay Card: Serial dry contact card providing 4 isolated dry output contacts, 1 isolated input; relays are programmable.

.5 Integrate into any industry standard Building Automation System (BAS); exact protocol requirements to be compatible with BAS serving building and confirmed with Mechanical Division BAS vendor.

.6 Monitored via any standard Internet browser (i.e. Internet Explorer and Netscape).

.7 Interfaces are hot swappable.

.2 Shutdown:

.1 Orderly, unattended, sequential shutdown of one or multiple computers powered by one UPS.

.2 Performed via in-network or out-of-network means.

.3 Order of shutdown user-defined, allowing maximization of runtime on battery for more critical systems.

.4 Capable of interfacing with an operating system's built-in shutdown routine.

.3 Notification:

.1 Send alerts to key personnel via email or SNMP traps.

.2 Alarm notification may also be sent by a network message.

.9 UPS Module Protection:

.1 Rectifier/Charger and Bypass protection provided through individual fusing of each phase.

.2 kAIC Rating: typically, 65 kAIC for up to 40 kW frame, and 100 kAIC for greater than 40 kW frames.

.3 Battery protection provided by thermal-magnetic molded-case circuit breakers in each battery cabinet (if standard battery pack is provided) or external protective device for an external battery.

.4 Electronic current limiting circuitry and fuses in inverter circuit provides output protection.

.10 UPS Integral Battery Management System:

.1 Provides battery time remaining while operating in normal mode and battery mode. Battery time available information displayed real-time, even under changing load conditions. Upon commissioning, battery runtime information available.

.2 Automatically tests battery system to ensure that battery can provide greater than 80% of its rated capacity. Testing batteries to not jeopardize operation of critical load. Upon detection of battery string(s) not capable of providing 80%, UPS system to alarm that battery needs attention/replacement. Battery test to detect following:

.1 open battery string;

.2 shorted battery string (current limit);

.3 battery capacity (runtime) less than 80% of "new" battery capacity.

.11 Transformers:

.1 Where transformers are required to transform voltages to required levels, ensure that dimensions of entire assembly can be accommodated in available spaces of installation location. Review with Contract Administrator prior to ordering.

.12 Lithium Ion Batteries:

.1 UPS module to use lithium ion (Li-ion) batteries designed for auxiliary power service in UPS application. Primary battery to be furnished with impact resistant plastic cases.

.2 Battery pack: factory preassembled and prewired, sealed, maintenance-free, lightweight, compact, long-life Li-ion type batteries to provide power for at least 12 minutes at full load rating capacity of UPS; to support load during loss of input power to rectifier; li-ion battery solution operating temperature rating to be 0 - 45ºC (32 - 113ºF).

.3 Battery Cabinet:

.1 Requires front access only for installation, service and maintenance.

.2 Includes DC rated circuit breaker to only provide protection to battery string within that battery cabinet.

.3 External battery cabinet to match depth, height and appearance of UPS cabinet. Power and control wiring between cabinets to be factory provided.

.4 Refer to additional cabinet requirements later in this Section.

.4 Battery Monitoring:

.1 Battery monitoring provided at module, rack, and system level Switched-mode power supply included to provide power for battery monitoring system.

.2 Communicates with UPS via dry contact.

.5 Safety Device and Level of Protection:

.1 System designed with highest level of protection built into battery system against 2 potential safety risks – over voltage and short circuit. Consists of 3 level of protection namely, cell, module and rack level.

.2 1st Level Protection - Battery management system and switch gear: Each battery rack is installed with main switch gear to isolate affected battery rack in event of a fault. Battery management system included in each rack to provide continuous monitoring of voltage and temperature of each cell within rack. Battery management system gathers and analyses rack current. In event of over voltage or short circuit, Battery management system trips breaker at rack level.

.3 2nd Level Protection - Fuse: Fuses are built into main switch gear at rack level. In event of a fault current (caused by short circuit) which breaker cannot be activated in shortest time, fuses to be activated to clear fault current without damaging cells.

.4 Protection - Cell: Several protection features incorporated into cell namely, safety function layer, multi-layers separator, safety vent, safety fuse and overcharged safety device. These safety features are to protect cell from overcharging and thermal runaway.

.13 Enclosures/Cabinets:

.1 Entire UPS system including accessories, transformer, maintenance bypass, and battery packs to be provided in matching dead front, free standing, and enamelled painted steel enclosures. Enclosures include safety shields behind doors and equipped with casters and leveling feet. Front doors include locks to prevent unauthorized entry.

.2 Enclosures to be suitably forced air fan ventilated and NEMA 1 rated with sprinkler-proof provisions including drip shield. Drip shield to be constructed of steel and finished to match UPS. Drip shield to be manufactured by UPS manufacturer. Ventilation louvres to be designed to prevent penetration of water spray from activated sprinklers onto live parts, and doors and component openings to be gasketed.

.3 No back or side clearance or access to be required for system. Serviceable subassemblies to be modular and capable of being replaced from front of UPS. Back and side enclosure covers to be capable of being located directly adjacent to a wall.

.4 Cable entries provisions provided to suit specific project installation requirements.

.14 Additional Requirements:.

.1 External wrap around maintenance by-pass:

.1 Multi-breaker manual maintenance bypass switch to isolate UPS module from commercial AC input and critical load; switch provides complete isolation of UPS for servicing.

.2 Switch is 3-position make before break switch, "NORMAL," "FULL BYPASS" and "SERVICE", interlocked between UPS and bypass to prohibit improper operation.

.3 Includes hardware and interconnecting cable for connection to UPS module.

.4 Installed in integrated matching cabinet to UPS cabinet.

.2 Output Breakers: As shown on drawings and as required.

.3 Spare Parts: Manufacturer’s recommended spare parts kit including one modular logic board of each type of replaceable logic board.

.4 Remote Annunciator Panel: Panel with 8 backlit status indicator lamps, identification labeling, audible horn, power supply and backbox.

.5 Integrated Cabinets with following:

.1 external maintenance bypass;

.2 isolation transformer;

.15 Warranty:

.1 UPS System:

.1 UPS manufacturer to warrant UPS system against defects in materials and workmanship for 24 months from date of substantial completion. Warranty to include all labour and materials with no deductible amounts.

.2 Batteries:

.1 System manufacturer to provide full comprehensive warranty on batteries against defects in materials and workmanship as follows:

.1 Li-ion batteries to be designed for minimum 10 years of service life;

.2 batteries to be complete with 24 months full exchange and 60 months prorated warranty, from date of substantial completion;

.3 after 60 months, battery manufacturer's standard warranty to be passed through to The City;

.4 batteries to be supplied by UPS manufacturer or UPS manufacturer authorized dealer.

.16 Testing, Start-up, Verification and Training:

.1 Manufacturer to provide standard factory testing and submit copy of detailed reports to Contract Administrator for review.

.2 Manufacturer's authorized technician to:

.1 provide onsite service of inspecting installation, perform start-up, testing and verification of equipment;

.2 to assist installing Contractor in installation and testing of equipment; coordination of work with Contractor;

.3 preparation and signing certification report letter that states system has passed manufacturer's testing and performs to manufacturer's requirements for application;

.4 be present to assist during third party testing;

.5 provide instructions on system operating and maintenance.

.3 Perform testing and verification work at times acceptable to The City and reviewed with Contract Administrator.

.4 Refer to Part 3 for additional requirements.

.17 Acceptable Manufacturers are:

.1 Eaton;

.2 Vertiv;

.3 Schneider MGE/APC;

.4 Mitsubishi.

3 Execution

3.1 INSTALLATION OF UPS UNITS

.1 Obtain required training from manufacturer's representative on any special installation procedures. Install units in accordance with manufacturer's instructions to suit specific installation requirements.

.2 Provide specified UPS units for equipment applications as detailed and as sized in specifications and/or on drawings. Place units on concrete pads where required, level and secure in position. Provide seismic restraints as required by local governing codes.

.3 Connect units in accordance with applicable Codes of authorities having jurisdiction and in accordance with manufacturer's instructions. Ensure adequate clearance is provided as per local governing code requirements and as required for access for operation and maintenance.

.4 Coordinate feed entries and exits to suit site conditions and equipment locations.

.5 Provide separate circuit to feed external maintenance bypass, as required.

.6 Provide EPO operator on recessed wall box in locations as reviewed with Contract Administrator. Provide wiring in conduit and connect to UPS unit. Provide engraved nameplate identifying operator.

.7 Review communication interfaces with Contract Administrator and BAS vendor. Provide alarm/communications circuits as required. Include for provision of conduits, boxes and control/signal wiring for interconnection to BAS. Coordinate with Mechanical Divisions BAS Contractor on location of BAS panel to be used for monitoring points and extend wiring in conduit from electrical equipment to location. Terminate in junction box leaving 3 m (10') of slack length of wiring (exact length to be coordinated between Mechanical and Electrical trades), for extending and termination to BAS panel by Mechanical Division BAS Contractor. Properly identify wiring and junction box.

.8 Materials and parts comprising UPS units to be new, of current manufacture, of a high grade and free from defects and imperfections and must have been in prior service, except as required during factory testing.

.9 Provide transparent plastic covers of suitable gauge during installation of large UPS unit to protect entire UPS equipment from dust and dirt during Project Work.

.10 Wiring and bolted connections of bus bars, lugs, and cables to be made in accordance with requirements of system manufacturer and applicable governing codes and standards. Electrical power connections to be torqued to required value and marked.

.11 Protect wire runs in a manner which separates power and control wiring. Make provisions in cabinets to permit installation of input and output cabling, using raceway or conduit.

.12 Where custom painting is specified, clean, prime, and paint UPS cabinets. Select colour from manufacturer's standard colour selection. Review finish with Contract Administrator prior to ordering.

.13 Provide drip shield for UPS units located in equipment rooms or other unfinished areas.

.14 Ground and bond equipment as per local electrical code requirements, to suit specific project requirements.

.15 Provide adequate ventilation to ensure that components are operated within their environmental ratings.

.16 Nameplates:

.1 Provide engraved lamacoid nameplates for equipment and components.

.2 Prior to manufacture of nameplates, review nomenclature with Contract Administrator in writing.

.3 During installation onsite, provide temporary labelling until permanent nameplates are installed.

.17 Where required, provide local governing electrical inspection authority approvals of power supply work.

3.2 INSPECTION, TESTING, START-UP, COMMISSIONING AND VERIFICATION WORK

.1 Include for onsite inspection, testing, start-up, commissioning and verification by manufacturer's field service personnel. Arrange for testing and commissioning to be performed by equipment supplier and witnessed by Contract Administrator and The City at time approved by The City and reviewed with Contract Administrator.

.2 Under direction of Contract Administrator, carry out complete performance acceptance tests and associated work at site on installed UPS units. Include for provision of full capacity load banks for testing. Manufacturer to provide monitoring equipment required to demonstrate successful operation.

.3 Tests to be conducted without disturbing user wiring and completed prior to connection of site critical loads.

.4 Perform visual inspection, mechanical inspection, electrical inspection, start-up and verification, including but not limited to:

.1 inspect equipment for damage and for proper installation;

.2 perform start-up procedure as per manufacturer's instructions and recommendations;

.3 test entire UPS system for automatic operation; testing must show successful uninterrupted full load transfer upon hydro failure to UPS and uninterrupted transfer from UPS to bypass;

.4 perform load testing, battery system testing, bypass test, and integrated testing with transfer switches and breakers feeding UPS unit and external bypass.

.5 inspect and test batteries for charge and charging capability;

.6 Inspect batteries for correct connections;

.7 test for low battery shut down;

.8 test battery monitoring system;

.9 test external maintenance bypass switch;

.10 load test for connected building load, and automatic operation of normal power failure; simulate power failure and power retransfer; simulate power failure of emergency generators and reconnection;

.11 testing to include use of artificial load bank with tests as follows:

.1 continuous test for 4 hours at full load;

.2 discharge batteries at full load for 15 minutes;

.3 recharge batteries for 60 minutes;

.4 supply full load.

.12 testing after installation to ensure IEEE 519 Harmonic levels are maintained at 100% and 50% load input and output;

.13 testing and demonstrating successful operation of EPO system;

.14 test system options and features to ensure proper operation.

.5 Onsite testing to include but not be limited to following detailed parameters:

.1 recording functional alarms and voltage levels at which alarm occurs, on UPS system;

.2 recording critical load alarms and voltage levels at which alarm occurs, on UPS system;

.3 recording minimum and maximum adjustment of voltage potentiometer on system;

.4 recording levels and checking functionality of battery equalize feature;

.5 recording load testing data with 0%, 50% and 100% load for function of input VAC/IAC/THD%, VDC/IDC (charging), output VAC/Φ-ΦV average/IAC, output kW/kVA/Hz and output voltage THD%;

.6 determine voltage regulation from 0-100% full load;

.7 determine voltage unbalance of system at 0%, 50% and 100% kW load;

.8 record transient response of system under load steps of 0-50%, 50-0%, 50-100%, 100-50%, 100% (UPS to bypass), 100% (bypass to UPS) and 100% simulated fuse failure; load percentages; Refer to kW rating of unit; record 3-phases of output voltage, 1-phase of output current and one phase of input voltage; attach printouts with report;

.9 perform battery discharge test; record battery details, specifications and operating data; load system to 100% kW load and record DCV and DCA at one-minute intervals from 0 to 20 minutes, record 3-phases of output voltage, one phase of output current and one phase of input voltage; attach printouts with report;

.10 record voltage levels and times at which Battery Discharge/Low Battery Warning/Low Battery Shutdown occur during discharge test;

.11 during battery charge (no load), record battery current limit (ADC, 10%) and reduced battery current limit (ADC, 1%);

.12 after battery recharge current has reached 0 A following battery capacity test, perform 125% overload test and verify/record overload alarm, input current limit (115%), reduced input current limit (100%), overload transfer alarm, auto-retransfer primed alarm and auto-retransfer successful (no alarm).

.6 Rectify deficiencies to satisfaction of The City.

.7 Document, sign, and date test results. Submit minimum one bound hard copy and electronic copy to Contract Administrator for review.

3.3 TRAINING

.1 Manufacturer's trained technician to perform onsite training of each user (including provision of user guides) prior to project completion to ensure that users are properly trained in the operation and maintenances of system.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Specific reference is made to the following sections:

.1 Section 01 33 00, Submittal Procedures

.2 Section 26 05 00, Basic Electrical Materials and Methods

1.2 CODES AND STANDARDS

.1 IEEE C62.11 Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1 kV)

.2 IEEE C62.22 Guide for the Application of Metal-Oxide Surge Arresters for Alternating Current Systems.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00, Submittal Procedures and Section 26 05 00, Basic Electrical Materials and Methods. Documents shall be submitted in the quantities and formats required by Section 01 33 00, Submittal Procedures.

.2 Product Data:

.1 Provide Manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, and limitations.

.3 Approval Documents and Drawing

.1 Approval Documents and Drawings

.1 Provide the following approval drawings to be submitted shall include, but not be limited to the following:

.1 Dimensioned layout and section view,

.2 Line and ground terminal connection type,

.3 Mounting installation detail,

.4 Nameplate data,

.5 Confirmed dimensions and weights,

.6 Instructions for field installation, assembly and disassembly.

.7 Detailed bill of materials including names of manufacturers and catalogue number of all components,

.2 Drawings for approval shall be submitted within eight (8) weeks after award of Contract in the quantities and formats required by Section 01 33 00, Submittal Procedures.

.4 Closeout Submittals:

.1 Provide submittals in accordance to Section 01 78 00 – Closeout Submittals.

.2 Operation and Maintenance (O&M) manual(s) shall be provided the quantities and formats required by Section 01 78 23, Operation and Maintenance Data.

.3 The O&M manual shall include, but not limited to, the following:

.1 Production test certificates signed by Manufacturer certifying that materials comply with specified performance characteristics and physical properties,

.2 Certified copies of reviewed test data and reports,

.3 Certified, Signed and Approved drawings,

.4 Product submittals,

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address,

.3 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with manufacturer’s recommendations in clean, dry and well-ventilated area.

.2 Store and protect the arresters from nicks, scratches and blemishes.

.3 Replace defective or damaged materials with new.

1.5 OPERATING CONDITIONS

.1 Provide all necessary safeguards and protection for optimal performance of the equipment.

.1	Location:	Outdoors
.2	Temperature:	-40°C to 40°C
.3	Relative Humidity:	20% to 100%
.4	Elevation:	239 m ASL
.5	Duty:	24 hours/day, 365 days/year.

2 Products

2.1 MATERIALS

.1 Meets ANSI/IEEE C62.11.

.2 Ratings

.1 Arresters shall be designed to operate satisfactorily for the following minimum basic electrical parameters:

.1	Nominal Voltage:	66 kV
.2	Rated Maximum Voltage:	72.5 kV
.3	MCOV:	70 kV
.4	Nominal Frequency:	60 Hz
.5	Housing:	Outdoor, Polymer
.6	Type:	Non-gapped

.3 Line arresters are mounted in parallel to the 66 kV cable terminators, as depicted in the Drawings. Provide mounting support at the ground terminal end to allow the arrester to be fasten to the cable standoff bracket.

.4 Arrester shall have hot line clamp connector on the line terminals side and ground leads at the grounding terminal end.

.5 Approved Equipment Manufacturer:

.1 Hubbell, Maclean or approved equal.

3 Execution

3.1 INSTALLATION

.1 Mount arresters across the 66 kV cable terminators as depicted in the Drawings.

.2 Connect line terminals to the phase conductors with the hot line clamp.

.3 Run arrester ground leads and use copper compression connectors to tie to the 4/0 AWG copper ground conductor on the pole to the ground grid.

3.2 CLEANING

.1 Upon completion, remove surplus materials, rubbish, tools and equipment.

3.3 WARRANTY

.1 The Vendor shall provide a complete warranty for all equipment, labor and materials for the arresters valid for a period of 2 years from the date following Substantial Completion of the Winnipeg North Garage Replacement construction contract.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

2 Products

2.1 SURGE PROTECTIVE DEVICES

.1 Switchgear / switchboards to be complete with either external or integral surge protective devices (SPDs). If external, unit to be connected onto bussing through dedicated breaker as recommended by manufacturer. If integral, unit to be factory installed into separate cubicle section and connected onto bussing through integral disconnect as recommended by manufacturer. SPD features include following:

.1 in accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;

.2 Type 1;

.3 maximum voltage protection rating to not exceed 700 V (120/208 V) or 1500 V (600/347V): L-N, L-G, N-G; 1200 V (120/208 V) or 3000 V (600V): L-L;

.4 minimum nominal discharge current rating of 10 kA;

.5 minimum short circuit current rating of 100 kA;

.6 peak surge current 250 KA per phase;

.7 high-performance EMI/RFI noise rejection filter;

.8 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of switchgear/switchboard;

.9 diagnostic package with status indicators on each phase;

.10 LCD surge counter display;

.11 audible alarm with silence button;

.12 Form C alarm contacts;

.13 maintenance free and not require any user intervention throughout its life;

.14 standard manufacturer’s minimum 5 years parts and labour warranty.

.2 Distribution panelboards as scheduled to be complete with integral surge protective devices (SPDs). Unit to be factory installed and connected onto bussing through integral disconnect/breaker as recommended by manufacturer. SPD features include:

.1 in accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;

.2 Type 1;

.3 maximum voltage protection rating to not exceed 700 V (120/208 V) or 1500 V (600/347V): L-N, L-G, N-G; 1200 V (120/208 V) or 3000 V (600V): L-L;

.4 minimum nominal discharge current rating of 10 kA;

.5 minimum short circuit current rating of 100 kA;

.6 peak surge current 150 KA per phase;

.7 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of panelboard;

.8 high-performance EMI/RFI noise rejection filter;

.9 indicator LED on units to identify protection integrity status of MOVs; indicator to be visible on front of switchgear/switchboard;

.10 diagnostic package with status indicators on each phase;

.11 audible alarm;

.12 Form C alarm contacts;

.13 maintenance free and not require any user intervention throughout its life;

.14 standard manufacturer's minimum 5 years parts and labour warranty.

2.2 ACCEPTABLE MANUFACTURERS

.1 Acceptable manufacturers are:

.1 Eaton Electric;

.2 Schneider Electric;

.3 Siemens Electric;

.4 APT (Advanced Protection Technologies).

3 Execution

3.1 INSTALLATION OF SPD UNITS

.1 Obtain required training from manufacturer's representative on any special installation procedures. Install units in accordance with manufacturer's instructions to suit specific installation requirements.

.2 Coordinate switchgear / switchboard configuration to accommodate dedicated cell to install SPD units for applications of integral mounting. Install dedicated disconnect/breaker device of type and rating in accordance with SPD manufacturer's requirements. Connect complete to SPD and bussing.

.3 Ensure that MOV condition LED indicator is visible from front of board/panel.

.4 Connect and make necessary incoming and outgoing power cable connections to equipment in strict accordance with equipment manufacturer's recommendations.

.5 Ground and bond components as per local electrical code requirements. Refer also to requirements of grounding and bonding article.

.6 Provide alarm/communications circuits as required. Include for provision of conduits, boxes and control/signal wiring for interconnection to BAS. Coordinate with Mechanical Divisions BAS Contractor on location of BAS panel to be used for monitoring points and extend wiring in conduit from SPD to location. Terminate in junction box leaving 3 m (10') of slack length of wiring (exact length to be coordinated between Mechanical and Electrical trades), for extending and termination to BAS panel by Mechanical Division BAS Contractor. Properly identify wiring and junction box.

.7 Manufacturer representative to assist installing Contractor in installation of equipment, testing equipment, performing start-up and verification of equipment.

.8 Be present to assist during third party testing.

.9 Perform testing at times reviewed with Contract Administrator.

.10 Provide instructions on system operating and maintenance.

.11 Additionally, refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

END OF SECTION

1 General

1.1 REFERENCES

.1 The following is a list of standards which may be referenced in this Section:

.1 Institute of Electrical and Electronic Engineers (IEEE): C62.41, Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits.

.2 Canadian Standards Association CSA C22.1 No. 141 Unit Equipment for Emergency Lighting.

.3 Certified Ballast Manufacturer (CBM).

.4 Federal Communications Commission (FCC).

.5 Illuminating Engineering Society of North America (IESNA).

.6 National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).

.7 American National Standards Institute (ANSI)

.1 ANSI C78.377-2008 Specifications for the Chromaticity of Solid State Lighting Products;

.2 ANSI C 82.77-2002 Harmonic Emission Limits – Related Power Quality Requirements for Lighting.

.3 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.4 ANSI C62.41.1-2002 – IEEE Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits.

.5 ANSI C62.41.2-2002 – IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000W and less) AC Power Circuits.

.6 ANSI C82.SSL1 – SSL Drivers;

.7 ANSI C82.77-2002 Harmonic Emission Limits

.8 Illuminating Engineering Society (IES).

.1 G-2-10 Guideline for the Application of General Illumination (“White”) Light-Emitting Diode (LED) Technologies;

.2 LM-79-08 Approved Method: Electrical and Photometric Testing of Solid-State Lighting Devices;

.3 LM-80-08 Approved Method: Measuring Lumen Depreciation of LED Light Sources;

.4 LM-82-12 Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature;

.5 RP-16-10 Nomenclature and Definitions for Illuminating Engineering;

.6 TM-16-05 Light Emitting Diode (LED) Sources and Systems;

.7 TM-21 -11 Projecting Long Term Lumen Maintenance of LED Light Sources.

.9 Canadian Standards Association (CSA International)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.

.2 CSA C22.2, General Requirements – Canadian Electrical Code Part II.

.3 CSA C22.2 No.141-15, Unit Equipment for Emergency Lighting. CSA C68.3 Power Cables with Thermoset Insulation.

.4 CSA C860-11, Performance of Internally-Lighted Exit Signs. CSA C21.2 300 V Control Cable.

.5 CSA C22.2 No.206, Lighting Poles.

.6 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steels/Structural Quality Steel

.7 CSA S16 (Steel Design)

.8 CSA A23.3 (Concrete design/anchor bolts)

.9 S6-14, Canadian Highway Bridge Design Code

.10 W59-13, Welded Steel Construction (Metal Arc Welding)

.11 National Fire Protection Association (NFPA)

.1 NFPA 101-2006, Life Safety Code IEEE 848 Standard Procedure for the Determination of the Ampacity Derating of Fire-Protected Cables

.12 National Building Code of Canada 2015(NBC)

.10 National Electrical Manufacturers Association (NEMA)

.1 SSL-1-2010 Electronic Drivers for LED Devices, Arrays, or Systems;

.2 SSL-3-2010 High-Power White LED Binning for General Illumination.

.11 Underwriters Laboratories, Inc. (ULC):

.12 NFPA No. 101 Life Safety Code.

.13 Manitoba Electrical Code.

1.2 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 00, General Electrical Requirements, and the requirements of Division 1.

.2 Where the Contract Administrator is to select colours and finish of lighting fixtures after award of Contract, it shall be the responsibility of the Contractor for Division 26 to obtain this information during the shop drawing submittal/review stage.

.3 Action Submittals:

.1 Shop Drawings:

.1 Interior Luminaires:

.1 Catalogue data sheets and pictures.

.2 Luminaire finish and metal gauge.

.3 Lens material, pattern, and thickness.

.4 Driver data sheet with system efficacy.

.5 Candle power distribution curves in two or more planes.

.6 Candle power chart 0 to 90 degrees.

.7 Lumen output chart.

.8 Mounting details.

.2 Exterior Luminaires:

.1 Catalogue data sheets and pictures.

.2 Luminaire finish and metal gauge.

.3 Lens material, pattern, and thickness.

.4 Driver data sheet with system efficacy.

.5 IESNA lighting classification and isolux diagram.

.6 Fastening details to wall or pole.

.7 EPA ratings

.8 For light poles, submit wind loading, EPA ratings, complete dimensions, foundation details, anchoring details and finish.

.3 LED Chipsets:

.1 Colours.

.2 Approximate life (in hours) to L70 requirements.

.3 Approximate initial lumens.

.4 Lumen maintenance curve.

.5 CRI.

.4 Drivers:

.1 Type.

.2 Wiring diagram.

.3 Approximate life (in hours)

.4 Nominal watts and input watts.

.5 Input voltage and power factor.

.6 Starting current.

.7 Temperature rating.

.8 Efficacy ratings.

.9 Low temperature characteristics.

.5 Photo Time Control:

.1 Wiring diagram.

.2 Contact ratings.

.6 Photocells:

.1 Voltage, and power consumption.

.2 Ampacity.

.3 Contacts and time delay.

.4 Operating levels.

.5 Enclosure type and dimensions.

.6 Mounting details

.7 Temperature range.

.7 Occupancy Sensors:

.1 Type.

.2 Switching capacity.

.3 Coverage.

.4 Time delay AUTO/OFF adjustment.

.5 Mounting details

.8 Low Voltage Remote Control Wiring System:

.1 Type.

.2 Switching capacity.

.3 Voltage rating.

.4 Wiring diagrams.

1.3 WARRANTY

.1 All lighting systems components shall be supplied the manufacturer's standard warranty, a minimum one year warranty.

.2 Extended warranties shall be submitted within Operating and Maintenance manuals as detailed in Section 26 05 00, General Electrical Requirements.

1.4 QUALITY ASSURANCE

.1 Pre-installation Meeting:

.1 Occupancy Sensors: Arrange a pre-installation meeting with the manufacturer's factory authorized representative at the project site, to verify placement of sensors and installation criteria.

.2 Extra Materials: Furnish, tag, and box for shipment and storage, the following spare parts:

Item	Quantity

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store in original cartons, in a dry and protected space.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: Remove for reuse and return by manufacturer of pallets, crates, packaging materials and padding.

.4 Divert unused metal materials from landfill to metal recycling facility.

.5 Disposal and recycling of fluorescent lamps as per local regulations.

.6 Disposal of old PCB filled ballasts.

2 Products

2.1 LUMINAIRES

.1 See the Lighting Fixture Schedule on the Drawings.

.2 Wire Leads: Minimum 18 AWG.

.3 Component Access: Accessible and replaceable without removing luminaire from ceiling.

.4 Soffit Installations:

.1 ULC Labeled: SUITABLE FOR DAMP LOCATIONS.

.2 Driver: Removable, prewired.

.5 Exterior Installations:

.1 ULC Labeled: SUITABLE FOR WET LOCATIONS.

.2 Driver: Removable, prewired.

.3 When factory installed photocells are provided, entire assembly shall have ULC label.

.6 Poles:

.1 Steel poles: to CSA C22.2 No.206 designed for underground wiring and:

.2 Hot Dip Galvanized after fabrication.

.3 Mounting on concrete anchor base without transformer base.

.4 Style: Refer to pole schedule

.5 Size: Refer to pole schedule

.6 Anchor bolts: Refer to pole schedule

.7 Finish: Refer to pole schedule

.8 Grounding lug.

2.2 LED CHIPSETS

.1 See the Luminaire Schedule.

2.3 DRIVERS

.1 General:

.1 Meet requirements for fixture light output, reliable starting, radio interference, total harmonic distortion, electromagnetic interference, and dielectric rating.

.2 Certified by electrical testing laboratory to conform to CBM specifications.

.3 Power factor of 98 percent or greater.

.4 Driver lifespan shall exceed 100,000 hours.

.5 Total harmonic distortion (THD) shall be less than 5 percent.

.6 Shall withstand line transients per IEEE C62.41, Cat A.

.7 Driver shall start lamp at a minimum temperature of 10 degrees Celsius for indoor fixtures, and -30 degree Celsius for outdoor fixtures.

.8 Driver input voltage shall match luminaire input voltage. Use of separate internal matching transformers shall only be permitted if the lifespan of the transformer exceeds that of the driver. Submit transformer cut sheet information with driver submittal if that is considered as part of the luminaire.

.9 Dimming control shall be according to Luminaire Schedule.

2.4 LIGHTING CONTROL

.1 Photocell:

.1 Automatic ON/OFF switching photo control.

.2 Housing: Self contained, die cast aluminum, unaffected by moisture, vibration, or temperature changes.

.3 Setting: ON at dusk and OFF at dawn.

.4 Time delay feature to prevent false switching.

.5 Field adjustable to control operating levels.

.6 Shall be compatible with LED driver and/or lighting control system.

.7 Manufacturers:

.1 Tork Inc.

.2 Paragon Electric Company.

.3 Or, approved equal.

.2 Occupancy Sensors:

.1 Dual Technology Units:

.1 Unit to be ceiling mounted for 180 degree or 360 degree coverage. Locate and aim sensors to achieve best coverage of controlled areas per the manufacturer's recommendations.

.2 Unit shall utilize both passive infrared and ultrasonic technologies and be easily programmed to accommodate different environmental and architectural conditions.

.3 Unit must detect up to 2,000 square feet with no blind spots.

.4 No audio dual technology units will be accepted.

.5 Shall be compatible with LED driver and/or lighting control system.

.2 Power Packs:

.1 Able to mount through a 13 mm knock out in a standard electrical enclosure and be an integrated, self contained unit consisting internally of an isolated load switching control relay and a transformer to provide low voltage power. Transformer shall provide power to a minimum of two sensors.

.2 Relay contacts shall have ratings of:

.1 13A, 120V AC tungsten.

.2 20A, 120V AC driver.

.3 Wiring: Control wiring between sensors and control units shall be Class II, 14 AWG, stranded, PVC insulated or Teflon jacketed cable approved for use in plenums, where applicable.

.4 General:

.1 Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to cycling of air conditioner or heating fans.

.2 Sensors shall have readily accessible, user adjustable controls for time delay and sensitivity.

.3 In event of failure, bypass manual OVERRIDE ON key shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

.4 Power Packs shall have an extra Form C (1 NO 1 NC) contact for interface with building system. Units shall be designed to be mountable in standard electrical box.

.5 All lighting control devices shall be compatible with the overall lighting system.

.6 Manufacturers:

.1 Lutron

.2 Leviton Mfg. of Canada, Ltd.

.3 Acuity nLight

.4 Encelium

.5 Or, approved equal

2.5 SURGE PROTECTION FOR LED SYSTEMS

.1 Luminaire manufacturers supplying exterior LED luminaires are to include surge protection for LED systems in accordance with IEEE and ANSI C62.41.2 transient surge requirements. Surge protection to be level of 6 kV/3 kA for low exposure conditions (low grade level landscape lighting) and, 10 kV/10 kA for high exposure conditions (pole mounted lighting).

3 Execution

3.1 LUMINAIRES

.1 General:

.1 Install in accordance with the manufacturer's recommendations.

.2 Provide proper hangers, pendants, and canopies as necessary for complete installation.

.3 Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building and to concrete pole bases required to safely mount.

.4 Install plumb and level.

.5 Mounting heights shown on the Drawings for pendant mounted luminaires are measured from bottom of luminaire to finished floor or finished grade, whichever is applicable.

.6 Mounting heights shown on the Drawings for wall mounted luminaires are measured from center of mounting plate to finished floor or finished grade, whichever is applicable.

.7 Install each luminaire outlet box with galvanized stud.

.8 Verify weight and mounting method of all luminaires prior to ordering and provide suitable support. Coordinate with Contractor for luminaires that require additional blocking or support. Luminaire mounting assemblies shall comply with all local seismic codes and regulations.

.9 Protective material to remain on luminaires until prior to commissioning. At commissioning, clean luminaires as in new condition.

.10 Do not daisy-chain light fixture wiring. Provide junction boxes and individual wiring to each light fixture.

.11 Avoid interference with, and provide clearance for, the equipment. Where the indicated locations for the lighting fixtures conflict with the locations for other equipment, change the locations for the lighting fixtures by the minimum distances necessary and as approved by the Contract Administrator.

.12 Where fixtures are specified to have two separate power sources within, provide all necessary barriers, etc., to isolate the two power sources as per the requirements of the authorities having jurisdiction.

.2 Pendant Mounted:

.1 Space single stem hangers or suspension cables, on continuous row luminaires as per manufacturer recommended specifications.

.2 Provide twin stem hangers or suspension cable, on single luminaires.

.3 Aircraft Cable Support shall use cable, anchorages, and intermediate supports recommended by luminaire manufacturer.

.4 Not all lighting appurtenances such as outlet box locations are shown on drawings. Position outlet boxes to coincide with suspension hangers and knockouts.

.5 For suspended lighting fixtures, provide the indicated mounting height clearances between the bottoms of the fixtures and the finished floors.

.3 Swinging Type: Provide, at each support, safety cable capable of supporting four times the vertical load from structure to luminaire.

.1 Brace suspended luminaires installed near ducts or other elements so that they do not swing into obstructions.

.4 Finished Areas:

.1 Install symmetrically with tile pattern.

.2 Locate with centerlines either on centerline of tile or on joint between adjacent tile runs.

.3 Install recessed luminaires tight to finished surface such that no spill light will show between ceilings and trims.

.4 Combustible Low Density Cellulose Fiberboard: Provide spacers and mount luminaires 38 mm from ceiling surface, or use fixtures suitable for mounting on low density ceilings.

.5 Junction Boxes:

.1 Flush and Recessed Luminaires: Locate a minimum of 300 mm from luminaire.

.2 In concealed locations, install junction boxes to be accessible by removing luminaire.

.3 For remote mounted junction boxes, refer to luminaire schedule and drawings.

.6 Wiring and Conduit:

.1 Provide wiring of temperature rating required by luminaire.

.2 Provide flexible steel conduit.

.7 Provide plaster frames when required by ceiling construction.

.8 Independent Supports:

.1 Provide each recessed luminaire with two safety chains or two No. 12 soft annealed galvanized steel wires of length needed to secure luminaire to building structure independent of ceiling structure.

.2 Tensile strength of chain or wire, and method of fastening to structure shall be adequate to support weight of luminaire.

.3 Fasten chain or wire to each end of luminaire.

.5 Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.

.1 Fixture Suspension: Provide threaded steel hanger rods or wires. Scissor type hangers not permitted.

.2 Rod Hangers shall be 3/16-inch minimum diameter, cadmium-plated threaded steel rod.

.3 Wires shall be ASTM A 641/A 641M, Class 3, soft temper, zinc coated steel, 12 gauge.

.4 Wires for humid spaces shall be ASTM A 580/A 580M, composition 302 or 304, annealed stainless steel, 12 gauge.

.5 Attachment to Steel Beams: Provide flanged beam clips and straight or angled hangers.

.6 Hang independent of pipes and ducts.

.6 Building Exterior: Flush mounted back box and concealed conduit, unless otherwise indicated in the Contract Documents.

.7 Pole fixtures:

.1 Install poles true and plumb, complete with brackets in accordance with manufacturer's instructions.

.2 Install luminaires on pole davits and install lamps.

.3 Check luminaire orientation, level and tilt.

.4 Confirm EPA ratings of entire pole assembly, including pole attachments.

3.2 LED CHIPSETS

.1 Provide in each fixture, number and type for which fixture is designed.

3.3 DRIVERS

.1 Factory installed by the fixture manufacturer.

.2 Replace noisy or defective drivers.

3.4 LIGHTING CONTROL

.1 Outdoor Luminaires: Controlled through relay-based lighting control system, with Photocells switch lights ON at dusk and OFF at dawn. Refer to lighting control schematics on drawings.

.2 Occupancy Sensors: Locate and aim sensors to achieve best coverage of controlled areas per the manufacturer's recommendations.

.3 Photocell sensors: Locate and aim sensors according sensor type and according to manufacturers recommendations.

3.5 EXIT LIGHT

.1 Install exit lights at locations indicated in the Contract Documents and as required.

.2 Install wall mounted units 2250 mm above finished floor in office areas and 300 mm above doorway openings in other areas.

.3 Feed from branch circuits dedicated to emergency lighting only. Refer to drawings.

3.6 TESTING

.1 The luminaires shall be properly tested with the lighting controls to ensure proper operation, zones, scenes, emergency operation, dusk/dawn signals, and other control settings.

.2 Malfunctioning Luminaires and Components: Replace or repair, then retest. Repeat procedure until units operate properly

3.7 CLEANING

.1 Remove labels and markings, except ULC or CSA listing mark.

.2 Wipe luminaires inside and out to remove construction dust.

.3 Clean luminaire plastic lenses with antistatic cleaners only.

.4 Waste Management: Separate waste materials for reuse and recycling.

.5 Touch up painted surfaces of luminaires and poles with matching paint ordered from manufacturer.

.6 Replace defective components at time of Substantial Performance of the Work.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 Unless otherwise indicated, lighting fixture bodies shall be of minimum 20 gauge cold rolled prime steel of rigid construction with knockouts as required.

.2 Any feature architectural luminaire, surface, or pendent mounted shall be manufactured from extruded aluminum.

.3 Fixture rigidity shall permit any suspension method without sag. Fluorescent fixtures shall be suitable for either individual or continuous mounting.

.4 Any luminaire requiring a continuous luminous appearance must be coordinated with the Contract Administrators prior to manufacturing. Contract Administrators must provide custom specifications (lengths) to manufacturer. Luminaire shall be installed as a single “system.”

.5 Fixtures shall be finished in baked white enamel with exposed surfaces matching the exposed t-bar ceiling specified in other sections and shall resist chipping, corrosion, and discolouration. Before finishing, all metal shall be chemically degreased and neutralized. Finish shall not be less than two coats of enamel, sprayed and baked on. Reflecting surfaces shall be white with an average reflectance of not less than 85%.

.6 Fixture lenses and diffusers shall be rigid enough to be self-supporting without sag, easily removable but not loose. Provide additional thickness of lens to prevent sag at no extra cost to the City.

.7 Where the Contract Administrator is to select colours and finish of lighting fixtures after award of Contract, it shall be the responsibility of the Contractor for Division 26 to obtain this information during the shop drawing submittal/review stage.

.8 Where fixtures are specified to have two separate power sources within, provide all necessary barriers, etc., to isolate the two power sources as per the requirements of the authorities having jurisdiction.

2 Products

2.1 MATERIALS

.1 Refer to drawings and– Lighting Schedules

3 Execution

3.1 INSTALLATIONS

.1 Any luminaire installed into a drywall ceiling must be accessible from below the ceiling for maintenance, including changing lamps, ballasts, LED modules, and LED drivers.

.2 All LED luminaires shall be composed of modular components for future maintenance by building staff. This includes replaceable LED driver and LED (printed circuit board, LED light bar, or LED module.)

.3 Any luminaire having a ridged lens shall be oriented where the ridge is on the interior of the luminaire and the exterior surface of the luminaire is smooth for ease of maintenance.

.4 Any suspended indirect luminaire with an uplight component shall be complete with a clear lens on top for ease of maintenance. Open top luminaires are not permitted.

.5 All luminaires intended for use in exterior locations or wet interior locations shall be gasketted and CUL listed for wet locations.

.6 All luminaires intended for use in exterior locations shall be liquid ingress protection (IP) rated at a minimum of IP65.

.7 All luminaires intended for use in exterior locations shall be fused. Pole mounted luminaires are excluded from this requirement if a fuse kit is installed in an accessible hand well in the pole.

.8 All exterior luminaires shall be constructed to emit zero light above the horizontal. Ensure the IES BUG Rating U = 0.

.9 All luminaires intended to be used in a corrosive environment (i.e. natatorium) shall be finished with a polyester powder coat.

.10 All Luminaires shall be installed accurately in line and level. Co-ordinate this work with other trades to ensure that their work is not held up by the work of this contract and that the luminaires are installed on schedule.

.11 All luminaires shall be installed in the standard manner for the type of luminaire and in accordance with the manufacturer's instructions. Luminaire studs or other equally secure methods of attachment shall be used throughout or as called for in the Luminaire Schedule.

.12 Luminaires shall be properly cleaned at the time of installation. Any luminaires showing marks or scratches due to handling or installation shall be replaced without additional cost to the City.

.13 Luminaires in service areas, mechanical, and electrical rooms shall be installed after the mechanical and electrical equipment is in place. The fixtures shall be located on site to clear all obstructions and to facilitate lamp removal, to the approval of the City.

.14 Luminaires and accessories shall not be fixed to or suspended in any way from mechanical pipes, ducts, or other components. If necessary, additional supports shall be installed to bridge the equipment.

.15 Provide luminaire mock-ups if detailed in the luminaire schedule, as required. No luminaire shall be put into manufacture until Contract Administrators and Project Manager's approval is received. Coordinate time with Contract Administrator and City to view mock-up.

.16 Where luminaires are mounted on wiring channels or assemblies provide necessary barrier to isolate dual power sources.

END OF SECTION

1 General

1.1 REFERENCE

.1 Section 26 05 00 – Common Work Results - Electrical

.2 Conform to relevant sections of the specifications for Division 26 and all other Divisions.

1.2 RELATED WORK

.1 Comply with relevant Sections of this and other Divisions of this Specification.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Exit Signs based on CSA C22.2 No141

.3 NRCAN/CSA C860 Certified.

2 Products

2.1 EXIT LIGHTS (TYPE X SERIES)

.1 Refer to luminaire schedule on drawings package.

2.2 GENERAL

.1 All exit lights shall have:

.1 Have no light leakage from joints and fittings.

.2 Have canopy and/or stem hangers to match housing.

.3 Meet the requirements of standard CSA C860.

.4 Must be NBC compliant; latest edition.

3 Execution

3.1 INSTALLATION

.1 Install exit lights where shown. Nominal mounting heights as shown on Luminaire schedule.

.2 Connect exit lights to circuits as indicated.

.3 Ensure that exit light circuit breaker is locked in ON position.

.4 Ensure that nowhere, are exit lights mounted less than 2m (6'-6") between underside of unit and finished floor.

.5 For ceiling mounting in areas with unfinished ceiling, mount unit alongside junction box, with or without canopy, and supply unit laterally with conduit (or with buried conduit, where allowed or specified, or by using the exit light canopy as a junction box where approved).

.6 Connect emergency sockets in exit light to output from battery of nearest emergency lighting unit central battery unit.

.7 Include in the Bid, for the installation of 20 (twenty) additional exit lights of each type 1, 2 and 3 or 4 , where directed on site.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – General Mechanical Requirements.

.2 Section 20 05 19 – Meters and Gauges.

.3 Section 20 07 00 – Mechanical Insulation.

.4 Section 23 25 00 – HVAC Water Treatment and Glycol Systems.

.5 Section 21 13 16 – Dry-Pipe Sprinkler Systems.

.6 Section 22 11 16 – Domestic Water Piping.

.7 Section 22 13 16 – Drainage, Waste and Vent Piping.

.8 Section 23 21 13 – Hydronic Piping.

.9 The following is a list of standards which may be referenced in this Section:

.1 Institute of Electrical and Electronics Engineers, Inc (IEEE): 515, Testing, Design, Installation and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications.

.2 CSA C22.2 No. 130-03-2008 Requirements for Electrical Resistance Heating Cables and Heating Device Sets.

.3 Electrical Safety Code (ESC)

1.2 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

.1 Action Submittals: Shop Drawings:

.1 Manufacturer's data sheet, installation instructions, electrical requirements and wiring diagrams for controller, sensors, circuits, remote alarm.

.2 Plastic Pipe Installations: Output adjustment factors for heating cable for the services indicated in the Contract Documents.

.3 Metal Pipe Installations: Output adjustment factors for heating cable for the services indicated in the Contract Documents.

.4 Pipe heat loss calculations for each pipe size to be heat traced.

.5 Layout drawings showing proposed location of the connection system and ambient thermostat.

.6 BAS interface wiring.

.7 Operation and maintenance manuals.

2 Products

.1 SYSTEM DESIGN REQUIREMENTS

.1 Design Heating Load:

.1 Maintain temperature as indicated on contract drawings and/ or schedules and include a 10 percent safety factor.

.2 Piping freeze protection

.3 Heat loss calculations shall be based on IEEE 515, Equation 1, Page 19.

2.2 ELECTRIC HEATING CABLING SYSTEM FOR PIPE TRACING

.1 Requirements for electric heating cabling for pipe tracing are shown on both Mechanical Division and Electrical Division drawings, and it is necessary to refer to drawings of both Divisions.

.2 nVent – "Raychem XL-Trace", ULC listed and labelled, CSA approved, self-regulating electric heat tracing cable as follows:

.1 consist of a continuous core of conductive polymer that is radiation cross-linked, extruded between two - 16 AWG nickel-plated copper bus wires that varies its power output in response to pipe temperature changes;

.2 with a modified polyolefin inner jacket and a tinned-copper braid to provide a ground path and enhance the cables ruggedness;

.3 have modified polyolefin outer jacket, to suit application;

.4 be compatible with piping being heated, as verified by independent testing company;

.5 have a self-regulating factor of at least 90 percent for 5/8XL series cable or at least 70 percent for 12XL series; self-regulating factor is defined as the percent reduction of the heating cable power output going from a 4°C (40°F) pipe temperature to 65°C (150°F) pipe temperature;

.6 cable to operate at voltages shown, without use of transformers.

.3 Wattage rating (5, 8 or 12 W/ft) of selected heating cable unless noted otherwise on drawings is to be based on manufacturer’s recommendations (design table or design software program) at drawing noted voltage, pipe lengths, insulation thickness, scheduled connected panelboard breakers and a minimum start-up ambient temperature as noted to suit site specific applications. Refer also to Mechanical Division drawings to confirm specific information on piping.

.4 Components exposed to elements to be weatherproof and corrosion resistant. Component enclosures to be NEMA 4X rated.

.5 Electronic controller to be provided to monitor cables and de-energize cables fully, during periods when ambient temperatures exceed set point. Controllers for single circuit control to be based on series ECW-GF with features as follows:

.1 LED window digital display of measured temperature, set points, and alarm conditions; alarm conditions to include temperature sensor failure, high or low temperature and ground fault;

.2 status LED indicators;

.3 integral 30 mA ground fault protection;

.4 programmable temperature settings;

.5 current rating up to 30 amperes;

.6 alarm contacts and LED indicator;

.7 non-volatile memory;

.8 wall mounting weatherproof NEMA 4X polycarbonate enclosure with wire guard protective cover or impact resistant clear lid cover;

.9 thermistor sensor of length of 7 m (25');

.10 pipe support bracket where mounted to pipe, as required.

.6 Accessories to also include following, as required:

.1 No. C75-100-A heating cable gland kit;

.2 power connection and end seal kits;

.3 splice, end seal and tee kits;

.4 "Electric Traced" pipe labels;

.5 aluminum tape for plastic pipe;

.6 glass cloth adhesive tape for metal pipe;

.7 contactors and relays, and mounting hardware as required.

.7 Components exposed to elements to be weatherproof and corrosion resistant.

.8 System Testing and Verification:

.1 Include for manufacturer’s authorized representative to inspect system installation, test system, and verify system.

.2 Manufacturer’s authorized technician to prepare and sign verification report letter that states system has passed manufacturer’s testing and performs to manufacturer’s requirements for application.

.9 Acceptable Manufacturers are:

.1 nVent - Raychem;

.2 Thermon – 3M.

2.3 SINGLE POINT CONTROLLERS

.1 nVent C910, CSA approved, ULC listed and labelled, single circuit local digital controller with features as follows:

.1 microprocessor based;

.2 compatible with selected heating cable;

.3 LED window digital display of measured temperature, set points, and alarm conditions; alarm conditions to include temperature sensor failure, high or low temperature and ground fault;

.4 2 temperature inputs;

.5 built-in integrated adjustable ground fault protection device;

.6 built-in self-test feature to verify proper functionality of heating cable system;

.7 can be configured for line-sensing, ambient sensing and mode that proportionally energizes the power to the heating cable to minimize energy based on ambient sensed conditions;

.8 able to communicate and integrate with various building automation systems via LonWorks, BACnet or Metasys protocols gateways;

.9 includes isolated alarm relay and a dry contact relay for alarm annunciation back to the BAS; following failure modes to be monitored by digital controller and reported back to BAS:

.1 loss of supply power;

.2 loss of control power;

.3 ground-fault;

.4 continuity or open circuit;

.5 low temperature.

.10 includes series RTD 3-wire platinum resistance temperature detectors with suitable length stainless steel flexible armoured copper extension wire and required connection accessories;

.11 NEMA 4X fiberglass reinforced plastic enclosure.

.2 Components exposed to elements to be weatherproof and corrosion resistant.

.3 Include required programming, installation and mounting accessories.

3 Execution

3.1 INSTALLATION

.1 Prior to submission of Bid, engage system manufacturer to review documents to ensure that requirements are included for proper operation and functionality of system for specific application in compliance with drawing and parameters and specification. Confirm type of piping, length and diameter of piping, insulation, and design temperature parameters with Mechanical Divisions and include in design and selection of system. Provide required components suitable for operation at voltages and for connection to breakers as noted on drawings and as required. It is necessary to review documents of both Electrical and Mechanical Divisions to determine and confirm exact requirements.

.2 Obtain required training from manufacturer's representative on any special installation procedures. Install products in accordance with manufacturer's instructions to suit specific installation requirements.

.3 Apply heating cable linearly (without spiralling) on pipe after pipe has been successfully pressure tested. Secure heating cable to pipe. Install cable in accordance with manufacturer's recommendations and in accordance with manufacturer's installation chart. Coordinate installation with pipe insulation installation under work of Mechanical Division.

.4 Provide identification labels at start and end of each run, every 4.5 m (15'), at bends, branches, risers both sides of wall and floor penetrations and at access doors.

.5 Where controller/thermostat does not have ground fault protection, connect pipe tracing power feeders to ground fault type breakers with trip set as per system manufacturer's recommendation and as per local governing electrical code requirements.

.6 Provide contactors/relays as required, to connect to thermostats and cables to energize/de-energize heating cable circuits through thermostat operations.

.7 Install controls, sensors, or thermostats in strict accordance with system manufacturer's installation recommendations. Clearly identify with nameplate, each control unit, sensor, or thermostat. Set thermostats to manufacturer's recommended upper limit temperature to ensure that heating cable is totally de-energized above set point. Provide thermostat as shown, or if not shown, provide one for each commonly grouped cables (i.e. in same area and performing similar application).

.8 Provide alarm/communications circuits as required. Include for provision of conduits, boxes and control/signal wiring for interconnection to fire alarm system, as required by local governing authorities and codes. Coordinate with fire alarm system vendor on location of panel to be used for interconnection of monitoring points and extend wiring in conduit from system heat tracing controls to location. Terminate in junction box leaving 3 m (10') of slack length of wiring (exact length to be coordinated to suit systems), for extending and termination to fire alarm panel. Properly identify wiring and junction box.

.9 Provide alarm/communications circuits as required. Include for provision of conduits, boxes and control/signal wiring for interconnection to BAS (if system not connected to fire alarm system). Coordinate with Mechanical Divisions BAS Contractor on location of BAS panel to be used for monitoring points and extend wiring in conduit from heat tracing controls to location. Terminate in junction box leaving 3 m (10') of slack length of wiring (exact length to be coordinated between Mechanical and Electrical trades), for extending and termination to BAS panel by Mechanical Division BAS Contractor. Properly identify wiring and junction box.

.10 After installation and before and after installing thermal insulation, subject self-regulating heating cable to insulation resistance testing using a 2500-VDC Megger. Minimum insulation resistance to be 1000 megohms or greater. Replace any cable with reading less than this value. Record heating-cable circuit capacitance as a means

.11 Testing and verification work to be performed by a manufacturer's authorized technician.

.12 Document results in test report signed by manufacturer's authorized technician. Submit copies to Contract Administrator.

.13 Additionally, refer to testing, coordination and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

3.2 TRAINING

.1 Manufacturer's trained technician to perform onsite training of each user (including the provision of user guides) prior to project completion to ensure that users are properly trained in the operation and maintenances of system.

.2 Refer to Instructions to The City specified in Section entitled Electrical Work General Instructions.

END OF SECTION

1 General

1.1 SUMMARY

.1 This section specifies the basic requirements for communications installations as indicated or required and includes requirements common to more than one specification section of this Division.

.2 This section expands upon and supplement the requirements specified in other Divisions including but not limited to 00, 01, 02, 07, 26, and 28.

1.2 REQUIREMENTS

.1 Examine the Contract Documents in their entirety (all trades/disciplines) for requirements or work which may be required as part of and/or affect work under the Division 27 specifications, regardless of whether such requirements or work are specifically indicated in this Division.

.2 Provide all items, articles, materials, operations and methods listed, mentioned and scheduled in the Contract Documents. Include all labour, equipment, tools, scaffolds and other incidentals necessary and required for a complete and functional installation.

.3 Consider the specifications as an integral part of the drawings which accompany them. Do not use the drawings or the specifications independently. Consider any item or subject omitted from one, mentioned or reasonably implied in the other, as properly and sufficiently specified and provide same under the work of this Division. The contractor and all sub-contractors are considered to be experts in their fields and are therefore expected to include all requirements specified or otherwise implied.

.4 Omissions from drawings or specifications, or incorrect description of details of work which are necessary to carry out intent of drawings and specifications, or which are customarily performed, shall not relieve Contractor from performing such omitted or incorrectly described detail of work. Perform such work once field measurements, field construction criteria, materials, catalog numbers and similar data has been verified and coordinated with each product data sheet and with requirements as indicated or intended in the Contract Documents at no additional cost to the City.

.5 Ensuring the requirements herein specified are fulfilled rests with the firm or organization holding a direct contract with the City or City's Representative. These specifications do not indicate or assign work to any sub-contractor or sub-contractors.

.6 Compliance with the provisions of these specifications does not relieve the contractor from the responsibilities of providing materials and equipment of proper design, mechanically and electrically suited to meet operating requirements at the specified service conditions.

1.3 RELATED DIVISIONS AND SECTIONS

.1 Division 01.

.2 Section 26 05 00 – Basic Electrical Materials and Methods.

.3 Section 26 05 27 – Grounding - Primary.

.4 Section 26 05 28 – Building Grounding.

.5 Section 27 05 26 – Grounding and Bonding for Communications Systems.

.6 Section 27 05 28 – Pathways for Communications Systems.

.7 Section 27 10 05 – Structured Cabling for Communications Systems.

1.4 DEFINITIONS

.1 The following terms may be found throughout the Division 27 specification sections and other related project documents (such as drawings) and are shown here for reference. For additional terms and their related definitions not shown here refer to glossary terms listed in applicable

codes, standards, manuals, as well as AVIXA Glossary of Audiovisual Terms, BICSI's ICT Terminology Handbook, and other related industry publications.

.1 acceptance plan: A facilitating agreement between parties (e.g., Contractor and the City or Contract Administrator) that defines satisfactory completion of a project task or complete project. It may include items on which the City's acceptance is dependent (e.g., delivery of record drawings, test certification).

.2 acceptance test: A test or set of tests performed to demonstrate satisfactory completion of a predetermined task or group of tasks on which acceptance is dependent.

.3 active equipment: The energized equipment used for receiving or transmitting analog or digital signals (e.g., switches, hubs, routers, private branch exchanges).

.4 administration: The methodology defining the documentation requirements of a cabling system and its containment, the labeling of functional elements, and the process by which moves, additions, and changes (MACs) are recorded. (ISO)

.5 aerial cable: Telecommunications cable installed on aerial supporting structures (e.g., poles, sides of buildings, other structures). (TIA)

.6 aerial plant: The components of aerial infrastructure, including poles, strand, guys, anchors, cable, and pole line hardware, used to provide telecommunications services between facilities.

.7 backbone cabling: The part of the cabling system between any of the following spaces: entrance facility room (EFR), main distribution frame (MDF), computer room (CR), data centre (DC), telecommunications room (TR), equipment room (ER), etc.

.8 biometrics: The authentication techniques based on measurable physical characteristics of individual users (e.g., fingerprints).

.9 bonding: The effective joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to safely conduct any current likely to be imposed.

.10 bonding conductor (BC): A conductor used specifically for the purpose of bonding.

.11 bonding conductor for telecommunications (BCT): A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground. (TIA)

.12 break-out cable: The multifiber or multiconductor cables where each optical fiber or conductor pair is further protected by an additional jacket and optional strength elements.

.13 building code: The construction requirements that are adjudicated into law by the authority having jurisdiction (AHJ).

.14 cabinet: free standing, floor–mounted or wall–mounted modular enclosure designed to house and protect cabinet–mounted electronic equipment and passive terminations.

.15 channel: The end–to–end transmission path between two points at which application specific equipment is connected; encompasses all the elements of the horizontal cabling link, plus the equipment cords in the telecommunications spaces and work area.

.16 code requirements: minimum requirements.

.17 commissioning: The start-up of a system that includes testing and adjusting the systems to ensure proper functioning and adherence to design criteria. Commissioning also includes the instruction of building representatives in the use of building systems.

.18 commissioning authority: The qualified person, company, or agency that plans, coordinates, and oversees the entire commissioning process. The commissioning authority also may be known as the commissioning agent.

.19 commissioning plan: The document prepared for each project that describes all aspects of the commissioning process, including schedules, responsibilities, documentation requirements, and functional performance test requirements.

.20 commissioning test plan: The document that details the pre-functional performance test, functional performance test, and necessary information for carrying out the testing process for each system, piece of equipment, or energy efficiency measure.

.21 common bonding network (CBN): The principal means for effecting telecommunications bonding and grounding (earthing) inside a building. It is the set of metallic components that are intentionally or incidentally interconnected to form the principal bonding network (BN) in a building. These components include structural steel or reinforcing rods, plumbing, alternating current (ac) power conduit, ac equipment ground (ACEG) conductors, cable trays, racks and cabinets, and bonding conductors. The CBN always has a mesh topology and is connected to the grounding electrode system.

.22 communications space: A space, area, or room primarily used to accommodate any type of communications equipment and systems. Example spaces include Telecommunications Room, Computer Room, Entrance Facility Room, Equipment Room, AV Equipment Room, etc.

.23 construction/interference drawings: Drawings, diagrams, illustrations, schedules, performance charts, and other data prepared and provided by the Contractor to illustrate details of a portion of work.

.24 Contractor: A person or company that signs a contract to supply materials or workers to perform a service or a job.

.25 demarcation point (demarc): 1. A point where the operational control or Cityship changes. (TIA) 2. The point of interface between service providers (SPs) and customer facilities. Also referred to as minimum point of entry (MPOE).

.26 Division: Refers to a Division number as identified in the MasterFormat® Numbers & Titles specifications-writing standard.

.27 entrance facility room (EFR) is the room where the outside plant media/carrier services appear in the facility, also known as a demarcation point. The EFR contains equipment used by City or carrier to hand–off/transition cable from outside plant into inside plant type.

.28 equipment cord: A cable assembly used to connect active electronics to horizontal or backbone cabling.

.29 equipment grounding conductor: The conductor used to connect the noncurrent-carrying metal parts of equipment, raceways, and other enclosures to the system-grounded conductor, the grounding electrode conductor, or both at the service equipment.

.30 equipment rack See rack.

.31 equipment room (ER): An environmentally controlled centralized space for telecommunications equipment that usually houses a main or intermediate cross-connect. (TIA)

.32 final acceptance: City's Representative's acceptance of project from Contractor.

.33 furnished by others: Receive delivery at job site or where called for and install.

.34 ground: A conducting connection, whether intentional or incidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

.35 grounding bushing: A fitting for attaching a ground wire to a conduit.

.36 handhole (HH): A structure similar to a small maintenance hole (MH) in which cable can be pulled, but not large enough for a person to fully enter to perform work.

.37 home run: A cabling pathway or cable installed without a splice or intermediate termination point between active electronics (e.g., switching, routing, data processing equipment) in a telecommunications space (e.g., equipment room (ER), telecommunications room (TR)) and an end user telecommunications outlet/connector in a work area.

.38 horizontal cabling: The part of the cabling system that extends from (and includes) the work area telecommunications outlet/connector to the horizontal cross-connect (HC (floor distributor (FD))) in the telecommunications room (TR).

.39 horizontal consolidation point/telecommunications outlet cable: A segment of horizontal cable between the consolidation point connector and the telecommunications outlet/connector. This cable should be easily moved for modular office rearrangement.

.40 horizontal cross-connect (HC): A group of connectors (e.g., patch panels, punch-down blocks) that allow horizontal, backbone, and equipment cabling to be cross-connected with patch cords or jumpers. Floor distributor (FD) is the international equivalent term for horizontal cross-connect.

.41 intermediate cross connect (IC) (building distributor (BD)): The connection point between a backbone cable that extends from the main cross-connect (MC (campus distributor (CD)) first-level backbone) and the backbone cable from the horizontal cross-connect (HC (floor distributor (FD)) second-level backbone). Building distributor (BD) is the international equivalent term for intermediate cross-connect (IC). Formerly called the intermediate distribution frame (IDF).

.42 launch cable: A length of optical fiber cable attached to the transmitting end of a path under test to allow the optical time domain reflectometer (OTDR) to accurately measure the path conditions. An OTDR cannot accurately measure conditions close to the launch point, as the signal has not yet stabilized.

.43 listed: Equipment included in a list published by an organization, acceptable to the authority having jurisdiction, that maintains periodic inspection of production of listed equipment, and whose listing states either that the equipment meets appropriate standards or has been tested and found suitable for use in a specified manner.

.44 main cross-connect (MC (campus distributor (CD))): The cross-connect normally located in the (main) equipment room for cross-connection and interconnection of entrance cables, first-level backbone cables, and equipment cables. Campus distributor is the international equivalent term for main cross-connect.

.45 main distribution frame (MDF) Areas: This technology space houses Layer 2/3 network switching gear and other main network distribution equipment and acts as the mid–connection point between the Core / Network and the TR / IDF / access zones for all connections.

.46 maintenance hole (MH (telecommunications)): 1. A vault located in the ground or earth as part of an underground duct system and used to facilitate placing, splicing, and maintenance of cables, as well as the placing of associated equipment, in which it is expected that a person will enter to perform work. Formerly called manhole. See also vault. 2. A hole through which access to an underground or enclosed structure may be gained.

.47 may: may is used to express an option or that which is permissible within the limits of the documents.

.48 City's Representative: Where noted, the term "City's Representative" includes, but is not limited to, City staff, Contract Administrator or Contract Administrator's appointed representative, City appointed Construction Supervisor/Administrator.

.49 passive equipment: non–electronic hardware and apparatus, e.g., equipment racks, cable trays, electrical protection, patch panels, wiring blocks, fiber optic shelves, etc.

.50 pathway: facility for the placement of communications cable. A pathway facility can be composed of several components including conduit, wireway, cable tray, surface raceway, under floor systems, overhead systems, raised floor, etc.

.51 permanent link: 1. The permanently installed portion of horizontal cabling (excludes cordage). 2. A test configuration for a link excluding test cords and patch cords or equipment cords. (TIA) Previously referred to as basic link.

.52 permanent link test configuration: The transmission path between two mated interfaces of generic cabling, excluding equipment cords, work area cords, and cross-connections but including the connecting hardware at each end. (ISO) Previously referred to as basic link test configuration.

.53 pigtail: One or more conductors or fibers with only one end terminated. (TIA)

.54 primary bonding busbar (PBB): A busbar placed in a convenient and accessible location and bonded, by means of the bonding conductor for telecommunications (BCT), to the building service equipment (power) ground. (TIA)

.55 product data sheet: A manufacturer's comprehensive document that provides detailed information about a particular product. It typically includes specifications, features, and other information.

.56 provide: Supply and install (including terminate, label, test, and certify, where applicable).

.57 pull box (PB): A device to access a closed raceway used to facilitate placing of wire or cables.

.58 pull tension: The pulling force that can be applied to a cable. (TIA)

.59 rack: An open, freestanding, floor–mounted or wall-mounted structure, typically made of aluminum or steel, used to mount equipment; usually referred to as a 2-post or 4-post equipment rack.

.60 relocate: Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready to use.

.61 replace: Remove and provide new item.

.62 rough-in: Pipe, duct, conduit, equipment layout and installation.

.63 secondary bonding busbar (SBB): A common point of connection for telecommunications systems and equipment bonding to ground and located in the telecommunications room (TR) or equipment room (ER). (TIA)

.64 shall: shall is used to express a requirement, i.e., a provision that the contractor is obliged to satisfy in order to comply with the Contract Documents.

.65 should: should is used to express a recommendation or that which is advised but not required.

.66 structured cabling system (SCS): A SCS is defined as all required cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber optic cable installed and configured to provide computer data and voice connectivity from each data or voice device to the network file server or voice network/switch designated as the service point of the local area network.

.67 telecommunications bonding backbone (TBB): A conductor that interconnects the primary bonding busbar (PBB) to the secondary bonding busbar (SBB).

.68 telecommunications equipment bonding conductor (TEBC): A bonding conductor that should be installed from each piece of equipment in the telecommunications room (TR) or equipment room (ER) to the secondary bonding busbar (SBB) or primary bonding busbar (PBB). TEBCs may also be connected to the rack grounding busbar (RGB), if the rack or cabinet has one.

.69 telecommunications outlet (TO): An assembly of components consisting of one or more connectors and a faceplate or housing.

.70 telecommunications room (TR) / intermediate distribution frame (IDF): A telecommunications space that differs from equipment rooms (ERs) and entrance facilities (EFs) in that this space is generally considered a floor-serving or tenant-serving (as opposed to building- or campus-serving) space that provides a connection point between backbone and horizontal cabling. The space also hosts access–layer switches and user network connections within each floor.

.71 this Division: Refers to MasterFormat® Numbers & Titles specifications-writing standard Division 27 – Communications and all associated specification sections identified with a specification section number starting with "27".

.72 waterfall: A drop-out panel attached to cable trays or troughs to support cables as they enter or leave the tray or trough and prevent crushing, pinching, and the violation of the cables' minimum bend radius.

1.5 REFERENCE CODES, ACTS, REGULATIONS, STANDARDS, AND MANUALS

.1 Ensure compliance with the most recent edition and/or version (including but not limited to addenda, amendments, errata sheets, and bulletins) of applicable codes, acts, regulations, standards, and manuals for the design, materials, fabrication, products, equipment, and installation of component parts and systems.

.2 Notwithstanding the forgoing, ensure compliance with the most onerous requirements where a conflict exists between requirements identified in the construction documents and/or requirements identified in any codes, acts, regulations, standards and/or manuals.

.3 Applicable codes, acts, and regulations include but are not limited to:

.1 Canada Occupational Health and Safety Regulations

.2 Canadian Electrical Code, Part I

.3 General Requirements - Canadian Electrical Code, Part II

.4 National Building Code of Canada

.5 National Fire Code of Canada

.6 Manitoba Building Code

.7 Manitoba Electrical Code

.8 Manitoba Fire Code

.9 The Workplace Safety and Health Act - Manitoba

.10 NFPA 1, Uniform Fire Code

.11 NFPA 70, National Electrical Code

.12 NFPA 72, National Fire Alarm and Signaling Code

.13 NFPA 101, Life Safety Code

.14 The Occupational Health and Safety Regulations - Saskatchewan

.15 Local codes, acts, regulations, and requirements

.4 Applicable standards include but are not limited to:

.1 ANSI C80.1, Electric Rigid Steel Conduit

.2 ANSI C80.3, Electrical Metallic Tubing - Steel (EMT-S)

.3 ANSI C80.6, Electrical Intermediate Metal Conduit

.4 ANSI Z136.1, American National Standard for Safe Use of Lasers

.5 ANSI Z136.2, Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources

.6 ANSI Z136.3, Safe Use of Lasers in Health Care

.7 ANSI Z136.4, Recommended Practice for Laser Safety Measurements for Classification and Hazard Evaluation

.8 ANSI Z136.5, Safe Use of Lasers in Educational Institutions

.9 ANSI Z136.6, Safe Use of Lasers Outdoors

.10 ANSI Z136.9, American National Standard for Safe Use of Lasers in Manufacturing Environments

.11 ANSI Z535.1, Safety Colors

.12 ANSI Z535.2, Environmental and Facility Safety Signs

.13 ANSI Z535.3, Criteria for Safety Symbols

.14 ANSI Z535.4, Product Safety Signs and Labels

.15 ANSI Z535.5, Safety Tags and Barricade Tapes (For Temporary Hazards)

.16 ANSI Z535.6, Product Safety Information in Product Manuals, Instructions and Other Collateral Materials

.17 ANSI/AVIXA A102.01, Measurement and Classification of Audio Coverage Uniformity in Listener Areas

.18 ANSI/AVIXA A103.01, Measurement and Classification of Spectral Balance of Sound Systems in Listener Areas

.19 ANSI/AVIXA D401.01, Documentation Requirements for Audiovisual Systems

.20 ANSI/AVIXA S601.01, Audiovisual Systems Energy Management

.21 ANSI/AVIXA V201.01, Image System Contrast Ratio

.22 ANSI/INFOCOMM 10, Audiovisual Systems Performance Verification

.23 ANSI/SCTE 03, Test Method for Coaxial Cable Structural Return Loss

.24 ANSI/SCTE 04, Test Method for "F" Connector Return Loss

.25 ANSI/SCTE 05, Test Method for "F" Connector Return Loss In-Line Pair

.26 ANSI/SCTE 32, Ampacity of Coaxial Telecommunications Cables

.27 ANSI/SCTE 44, Test Method for DC Loop Resistance

.28 ANSI/SCTE 47, Test Method for Coaxial Cable Attenuation

.29 ANSI/SCTE 49, Test Method for Velocity of Propagation

.30 ANSI/SCTE 66, Test Method for Coaxial Cable Impedance

.31 ANSI/TIA-222-I, Structural Standard for Antenna Supporting Structures, Antennas and Small Wind Turbine Support Structures

.32 ANSI/TIA-526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Adoption of IEC 61280-4-2 edition 2: Fibre-Optic Communications Subsystem Test Procedures – Part 4-2: Installed Cable Plant – Single-Mode Attenuation and Optical Return Loss Measurement

.33 ANSI/TIA-526-14, Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 edition 3.1, Fiber Optic Communications Subsystem Test Procedures- Part 4-1: Installed Cable Plant- Multimode Attenuation Measurement

.34 ANSI/TIA-568.0, Generic Telecommunications Cabling for Customer Premises

.35 ANSI/TIA-568.1, Commercial Building Telecommunications Infrastructure Standard

.36 ANSI/TIA-568.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard

.37 ANSI/TIA-568.3, Optical Fiber Cabling and Components Standard

.38 ANSI/TIA-568.4, Broadband Coaxial Cabling and Components Standard

.39 ANSI/TIA-568.5, Balanced Single Twisted-pair Telecommunications Cabling and Components Standard

.40 ANSI/TIA-569, Telecommunications Pathways and Spaces

.41 ANSI/TIA-570, Residential Telecommunications Infrastructure Standard

.42 ANSI/TIA-598, Optical Fiber Cable Color Coding

.43 ANSI/TIA-606, Administration Standard for Telecommunications Infrastructure

.44 ANSI/TIA-607, Telecommunications Bonding and Grounding (Earthing) for Customer Premises

.45 ANSI/TIA-758, Customer-Owned Outside Plant Telecommunications Infrastructure Standard

.46 ANSI/TIA-862, Structured Cabling Infrastructure Standard for Intelligent Building Systems

.47 ANSI/TIA-942, Telecommunications Infrastructure Standard for Data Centers

.48 ANSI/TIA-1005, Telecommunications Infrastructure Standard for Industrial Premises

.49 ANSI/TIA-1152, Requirements for Field Test Instruments and Measurements for Balanced Twisted- Pair Cabling

.50 ANSI/TIA-1179, Healthcare Facility Telecommunications Infrastructure Standard

.51 ANSI/TIA-1183, Measurement Methods and Test Fixtures for Balun-less Measurements of Balanced Components and Systems

.52 ANSI/TIA-4966, Telecommunications Infrastructure Standard for Educational Facilities

.53 ANSI/TIA-5017, Telecommunications Physical Network Security Standard

.54 ASTM A48/A48M, Standard Specification for Gray Iron Castings

.55 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.56 ASTM A475, Standard Specification for Metallic-Coated Steel Wire Strand

.57 ASTM A510M, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel

.58 ASTM A641M, Standard Specification for Zinc–Coated (Galvanized) Carbon Steel Wire

.59 ASTM A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.60 ASTM B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

.61 ASTM C33/C33M, Standard Specification for Concrete Aggregates

.62 ASTM C136/C136M, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

.63 ASTM C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

.64 ASTM C858, Standard Specification for Underground Precast Concrete Utility Structures

.65 ASTM C1037, Standard Practice for Inspection of Underground Precast Concrete Utility Structures

.66 ASTM C1821/C1821M, Standard Practice for Installation of Underground Circular Precast Concrete Manhole Structures

.67 ASTM D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

.68 ASTM D3363, Standard Test Method for Film Hardness by Pencil Test

.69 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

.70 ASTM E814, Standard Test Method for Fire Tests of Penetration Firestop Systems

.71 ASTM E1725, Standard Test Methods for Fire Tests of Fire-Resistive Barrier Systems for Electrical System Components

.72 AVIXA, AV/IT Infrastructure Guidelines for Courts

.73 AVIXA F501.01, Cable Labeling for Audiovisual Systems

.74 AVIXA F502.01, Rack Building for Audiovisual Systems

.75 AVIXA V202.01, Display Image Size for 2D Content in Audiovisual Systems

.76 AVIXA RP-C303.01, Recommended Practices for Security in Networked AV Systems

.77 BICSI 001, Information and Communication Technology Systems Design and Implementation Best Practices for Educational Institutions and Facilities

.78 BICSI 002, Data Centre Design and Implementation Best Practices

.79 BCISI 003, Building Information Modeling (BIM) Practices for Information Communications Technology Systems

.80 BICSI 004, Information Communication Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities

.81 BICSI 006, Distributed Antenna System (DAS) Design and Implementation Best Practices

.82 BICSI 007, Information Communication Technology Systems Design and Implementation Best Practices for Intelligent Buildings and Premises

.83 BICSI 008, Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices

.84 BICSI 009, Data Centre Operations and Maintenance Best Practices

.85 BICSI N1, Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure

.86 BICSI N2, Practices for the Installation of Telecommunications and ICT Cabling Intended to Support Remote Power Applications

.87 BICSI N3, Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure

.88 BICSI G1, ICT Outside Plant Construction and Installation: General Practices

.89 BICSI G2.1, ICT Outside Plant Construction and Installation: Pole Setting, Anchoring, and Guying

.90 BICSI G2.2, ICT Outside Plant Construction and Installation: Aerial Cable Installation

.91 BICSI G4, ICT Outside Plant Construction and Installation: Direct Buried Facilities

.92 CAN/ULC-S102.4, Standard Method of Test for Fire and Smoke Characteristics of Electrical Wiring, Cables and Non-Metallic Raceways

.93 CAN/ULC-S115, Standard Method of Fire Tests of Firestop Systems

.94 CAN/ULC-S139, Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables

.95 CSA C22.2 No. 0.15, Adhesive Labels

.96 CSA C22.2 No. 0.3, Test Methods for Electrical Wires and Cables

.97 CSA C22.2 NO. 18.1, Metallic outlet boxes

.98 CSA C22.2 NO. 18.2, Nonmetallic outlet boxes

.99 CSA C22.2 NO. 18.3, Conduit, tubing, and cable fittings

.100 CSA C22.2 NO. 18.4, Hardware for the support of conduit, tubing, and cable

.101 CSA C22.2 NO. 18.5, Positioning devices

.102 CSA C22.2 NO. 40, Junction and pull boxes

.103 CSA C22.2 NO. 45.1, Electrical rigid metal conduit - Steel

.104 CSA C22.2 NO. 56, Flexible metal conduit and liquid-tight flexible metal conduit

.105 CSA C22.2 NO. 83, Electrical metallic tubing

.106 CSA C22.2 NO. 83.1, Electrical Metallic Tubing - Steel

.107 CSA C22.2 NO. 85, Rigid PVC boxes and fittings

.108 CSA C22.2 No. 126.1, Metal Cable Tray Systems

.109 CSA C22.2 No. 126.2, Nonmetallic Cable Tray Systems

.110 CSA C22.2 NO. 211.2, Rigid PVC (unplasticized) conduit

.111 CSA C22.2 No. 214, Standard for Safety for Communications Cables

.112 CSA C22.2 NO. 227.1, Electrical nonmetallic tubing

.113 CSA C22.2 No. 2556, Wire and Cable Test Methods

.114 CSA C22.2 No. 62368-1, Audio/video, information and communication technology equipment – Part 1: Safety requirements

.115 CSA Z462, Workplace Electrical Safety

.116 ECIA EIA/ECA-310, Cabinets, Racks, Panels, and Associated Equipment

.117 IEC 61386-1, Conduit systems for cable management - Part 1: General requirements

.118 IEC 61386-21, Conduit systems for cable management - Part 21: Particular requirements - Rigid conduit systems

.119 IEC 61386-23, Conduit systems for cable management - Part 23: Particular requirements - Flexible conduit systems

.120 IEC 61386-24, Conduit systems for cable management - Part 24: Particular requirements - Conduit systems buried underground

.121 IEC 61537, Cable management – Cable tray systems and cable ladder systems

.122 IEEE 802.3, IEEE Standard for Ethernet

.123 IEEE 802.11, IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications

.124 IEEE 8802-15-4, IEEE/ISO/IEC International Standard -- Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Specific requirements -- Part 15-4: Wireless medium access control (MAC) and physical layer (PHY) specifications for low-rate wireless personal area networks (WPANs)

.125 IEEE 8802-15-6, ISO/IEC/IEEE International Standard - Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Specific requirements -- Part 15-6: Wireless body area network

.126 IES/AVIXA RP-38-17, Recommended Practice for Lighting Performance for Small to Medium Sized Videoconferencing Rooms

.127 ISO/IEC 11801-1, Information technology — Generic cabling for customer premises — Part 1: General requirements

.128 ISO/IEC 11801-2, Information technology — Generic cabling for customer premises — Part 2: Office premises

.129 ISO/IEC 11801-3, Information technology — Generic cabling for customer premises — Part 3: Industrial premises

.130 ISO/IEC 11801-5, Information technology — Generic cabling for customer premises — Part 5: Data centres

.131 ISO/IEC 11801-6, Information technology — Generic cabling for customer premises — Part 6: Distributed building services

.132 ISO/IEC 14763-2, Information technology — Implementation and operation of customer premises cabling — Part 2: Planning and installation

.133 ISO/IEC 14763-3, Information technology — Implementation and operation of customer premises cabling — Part 3: Testing of optical fibre cabling

.134 ISO/IEC 14763-4, Information technology — Implementation and operation of customer premises cabling — Part 4: Measurement of end-to-end (E2E)-Links

.135 NEMA VE-2, Cable Installation Guidelines

.136 TIA-455, General Requirements for Standard Test Procedures for Optical Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components

.137 TIA TSB-62, Informative Test Methods (ITMs) for Fiber-Optic Fibers, Cables, Opto-Electronic Sources and Detectors, Sensors, Connecting and Terminating Devices, and Other Fiber-Optic Components

.138 TIA TSB-142, Optical Return Loss Meters - Measurement and Application Issues

.139 TIA TSB-155, Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T

.140 TIA TSB-162, Telecommunications Cabling Guidelines for Wireless Access Points

.141 TIA TSB-184, Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling

.142 TIA TSB-185, Environmental Classification (MICE) Tutorial

.143 TIA TSB-4979, Practical Considerations for Implementation of Encircled Flux Launch Conditions in the Field

.144 UL 969, Marking and Labelling Systems

.145 UL 969A, ANSI/CAN/UL Standard for Marking and Labeling Systems - Flag Labels, Flag Tags, Wrap-Around Labels and Related Products

.146 UL 2416, Audio/Video, Information and Communication Technology Equipment Cabinet, Enclosure and Rack Systems

.5 Applicable manuals include but are not limited to:

.1 ANSI/INFOCOMM 2M-2010, Standard Guide for Audiovisual Systems Design and Coordination Processes

.2 ANSI/INFOCOMM 2M-2010 Handbook, AV Implementation Handbook

.3 BICSI ICT IPFG Vol 1, ICT Installation Practices Field Guide, Volume 1 – General Cabling

.4 BICSI ICT IPFG Vol 2, ICT Installation Practices Field Guide Volume 2 – Copper Cabling

.5 BICSI ICT IPFG Vol 3, ICT Installation Practices Field Guide Volume 3 – Optical Fiber Cabling

.6 BICSI ITSIMM, Information Technology Systems Installation Methods Manual

.7 BICSI OSPDRM, Outside Plant Design Reference Manual

.8 BICSI TDMM, Telecommunications Distribution Methods Manual

.9 BICSI TPMRM, Telecommunications Project Management Reference Manual

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Comply with submittal procedures as identified in Division 01 specifications sections.

.2 Review of any submittal shall not relieve the Contractor of responsibility for any deviation from the contract documents.

.1 Prior to installation start submit the following for review:

.1 Evidence (certificates) of industry recognized credentials and/or certifications of project personnel (project manager, lead hand, technicians, etc.) related to the equipment and/or products to be provided as specified in the Division 27 specification sections.

.2 Evidence (certificates) of factory and/or manufacturer trained and authorized personnel for the installation and service of equipment to be provided.

.3 Proposed products list (including quantities).

.4 Supply and installation schedule and log.

.5 Cable, device, and equipment labelling schemes.

.6 Product data sheets: Manufacturer's printed literature and data sheets for all products including product characteristics, physical size, finish, limitations, performance criteria and/or characteristics, as well as installation, operation and maintenance instructions.

.1 Ensure product submittals are complete and organized following the same order as specified in the specifications sections including clear indication (written) of which specification section each product relates to.

.2 Where multiple product model / part numbers are shown on a submission page(s), highlight the specific product / model number(s).

.3 Partial, disordered, or non-annotated submittals may be rejected at the reviewer’s discretion.

.7 Construction/interference drawings: Ensure all construction/interference drawings are coordinated with and approved by all trades (prior to commencement of any site work). Base construction/interference drawings on reviewed product data sheets. As part of the construction/interference drawings include:

.1 Floor and site plans showing planned locations of devices and cable routing paths with cable types and quantity identified.

.2 Fully dimensioned drawings showing sleeves and openings through structure. Indicate locations and weights on all load points.

.3 Fully dimensioned drawings of products and services in communications spaces, service and ceiling spaces, and all other critical locations. Indicate all details pertaining to access, clearances, sleeves, connections, and elevations of pipes, ducts and conduits.

.4 Wiring diagrams.

.5 Cabinet and rack elevation drawings (front and rear) detailing:

.1 Cabinet and rack identification (cabinet/rack number, room identification, etc.).

.2 All project specified equipment (patch panels, cable managers, PDUs, etc.) with identification tags.

.3 City supplied, contractor installed equipment with identification tags and/or keynotes.

.2 Prior to installation start and within seven (7) business days after delivery of each cable reel and box to the project site submit the following for review:

.1 Manufacturer's product test data / reports for optical fibre cable(s).

.2 Post-delivery on-reel (prior to installation) OTDR testing of all optical fibre strands.

.3 Record of visual inspection of all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport. Replace visibly damaged goods at no additional cost to the City.

.3 No less than ten (10) business days prior to start of commissioning and testing of cables, devices, equipment, and systems, comply with quality requirements as identified in Division 01 specifications sections and submit the following for review:

.1 Manufacturer's catalog sheets and specifications for all test equipment.

.2 Test equipment serial number(s).

.3 Test equipment calibration certificate(s) confirming the equipment is within its twelve (12) month calibration period. Exclude from use any test equipment not within its twelve (12) month calibration period.

.4 Evidence (certificates) of test equipment manufacturer training for each technician tasked with testing of cabling, equipment, and/or systems. Only trained technicians who have successfully attended training programs for each type of required test and tester and have obtained certificates as proof thereof shall execute the tests.

.5 Schedule (list) of all cables, devices, equipment, and systems to be tested (100% of all cables, devices, equipment, and systems installed) and exact date(s) for testing and commissioning.

.6 Invitation to the City and City's representative to witness and/or review (at their discretion) any testing or commissioning activities.

.4 Project record documentation: Comply with execution and closeout requirements as identified in Division 01 specification sections.

.1 Maintain timely and accurate records of actual device locations.

.2 Document major deviations in work as actually installed. Include notations reflecting as-built conditions of any additions to or variation from original drawings.

.3 Include actual locations of installed conduits and cable tray.

.4 Within ten (10) business days after final acceptance submit for review project record documentation `s including but not limited to:

.1 Previously submitted, reviewed, and stamped product data submittals.

.2 Structured cabling system manufacturer confirmation of registration of all copper and optical fibre cabling links.

.3 Manufacturer's warranty documents for all cabling, devices, and equipment.

.4 Manufacturer's certification documents for all cabling, devices, and equipment.

.5 Contractor's warranty documents (stipulating no less than one (1) year parts and labour warranty).

.6 Complete set of electronic record drawings (confirm format with City's Representative), including:

.1 Floor and site plans showing locations of devices and cable routing paths with cable types, quantity, and termination information identified.

.2 Locations of installed cabling pathways (j-hooks, conduits, tray, etc.).

.3 Location and identification of distribution cabinets and of equipment located inside cabinets and communications spaces.

.4 Terminal information, outlet numbering, and pair count information at each distribution frame or location.

.5 Schematic drawings of backbone cabling.

.7 Photographic record of cabling pathways prior to concealment of interior and exterior cabling pathways.

.8 Cable testing documentation including:

.1 Complete listing of conductor, pair, and strand assignment records for copper and optical fibre cabling.

.2 Copper cabling test results.

.3 Optical fibre cabling test results.

.9 Standalone and integrated systems testing documentation including:

.1 Power on and activation.

.2 Input / output testing.

.3 Control functional testing.

.4 Programming functional testing.

.5 Network connectivity testing.

.6 Systems integration and interface testing.

1.7 PROGRESS PAYMENTS

.1 Comply with payment procedures requirements as identified in Division 01 specification section(s).

.2 Submit a complete breakdown of the Contract with each progress billing, indicating percentage of work complete, in a form acceptable to the City and/or City's Representative.

1.8 VALUATION OF CHANGES

.1 Refer to and conform to the requirements set out in Division 01.

.2 Submissions will be scrutinized by the Contract Administrator and therefore require complete detailed itemization of all material, labour, unit prices and overhead and profit mark-ups.

1.9 ADDITIONAL ENGINEERING SERVICES

.1 Pay City for cost of additional engineering services, including:

.1 To examine and evaluate changes proposed by Contractor for convenience of Contractor.

.2 As result of Contractor's errors, omissions or failure to conform to requirements of Contract Documents.

1.10 SEQUENCING AND SCHEDULING

.1 Sequence and schedule work in accordance with Division 01 specifications sections.

.2 Prepare and submit a construction progress schedule in accordance with Division 01 specifications sections.

.3 Coordinate all activities with the overall construction schedule.

1.11 EXPEDITING

.1 Continuously check and expedite delivery of equipment and materials.

.2 As required, inspect equipment, etc. at the source of manufacture.

.3 Continuously check and expedite the flow of necessary information to and from all stakeholders.

.4 Immediately inform the City's Representative where information is required from them, and attend to any request for information, details, dimensions, etc. from them.

1.12 PROJECT MEETINGS

.1 Comply with administrative requirements as identified in Division 01 specifications sections.

.2 Pre-Construction Meeting: Attend meeting when requested. Come prepared with questions and prepared to answer questions about communications work.

.3 Progress Meetings: Attend meetings when requested. Come prepared with questions and prepared to answer questions about communications work.

1.13 COORDINATION

.1 Comply with administrative requirements as identified in Division 01 specifications sections.

.2 Coordinate the details of facility equipment and construction for all specification Divisions, which affect the work covered under this Division

.3 Coordinate work of this section with requirements of local telephone exchange carrier(s), equipment suppliers, furniture suppliers, and other trades as required.

.1 Meet with representatives of above organizations and City's Representative to exchange information and agree on details of equipment arrangements and installation interfaces.

.2 Record agreements reached in meetings and distribute record of agreements to other stakeholders.

.3 Adjust arrangements and locations of distribution frames, patch panels, and cross connects in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

1.14 QUALITY ASSURANCE

.1 Manufacturer qualifications

.1 Only manufacturers regularly and currently engaged in the production of cabling, equipment and accessories provided shall be considered.

.2 Similar equipment shall be in satisfactory and efficient operation on at least three (3) similarly complex installations for not less than three (3) years.

.3 Suppliers and installers shall be factory or manufacturer trained and authorized personnel for installation and service of equipment provided.

.2 Contractor qualifications

.1 Certified by cabling, device, equipment and/or system manufacturers. Adhere to engineering, installation and testing procedures and utilize authorized manufacturer components and distribution channels in provisioning this project.

.2 Experienced in communications work and able to demonstrate direct experience on recent systems of similar type and size.

.3 Technicians shall be competent, skilled and certified by cabling, devices, equipment and systems manufacturers.

.4 Utilize and maintain tools and equipment necessary for successful installation and testing of cabling, devices, equipment and systems, and have personnel adequately trained in use of such tools and equipment.

.5 Employ full-time Project Manager registered by a current recognized organization such as AVIXA, BICSI, PMI or SSGI. Contractor shall not remove approved Project Manager from project without approval of City's Representative, unless that Project Manager leaves employ of Contractor. Project Manager shall:

.1 Be Contractor's representative, speak and respond for Contractor.

.2 Make at least one (1) day per week visit to construction site to determine progress of construction and be available to resolve contract issues.

.3 Regulatory requirements

.1 Comply with regulatory requirements as identified in Division 01 specifications section(s).

.2 Comply with applicable codes, acts, and regulations of federal, provincial, territory, and local governmental agencies.

.3 Ensure equipment and material is certified for use in Canada and bear an identifying stamp or label of the Nationally Recognized Testing Laboratory in Canada (ie CSA, ULC, ETL, etc.). Where there is no alternative to supplying equipment which is certified for use in Canada, obtain special approval from the AHJ.

.4 Comply with applicable standards and manuals.

.4 Intent of documents

.1 Comply with administrative requirements as identified in Division 01 specifications sections.

.2 Drawings for the communications work are performance drawings and diagrammatic, intended to convey the scope of the work and indicate general arrangement and approximate location of cabinets, racks, equipment, and devices. Exact locations of cabinets, racks, equipment, raceways, cabling, devices and related components are

subject to approval of City's Representative. Drawings do not intend to show architectural and structural details.

.3 Refer any conflicts within the Contract Documents to the City's Representative for resolution.

.4 Follow as closely as practicable the schematic design shown on the drawings. Make all necessary measurements in the field to verify exact locations and ensure precise location and fit of specified items in accordance with the drawings. Make no substantial alterations without prior approval of the City's Representative.

1.15 PROJECT CONDITIONS

.1 Comply with requirements as identified in Division 01 specifications sections.

.2 Use of Premises

.1 Schedule necessary shutdowns of plant services with City's Representative and obtain written permission from City's Representative.

.3 Work Restrictions

.1 Hours of Work are limited to Monday-Friday, 7:30 a.m. – 5:30 p.m.

.4 Special Procedures

.1 Apply for access to restricted areas such as operating rooms, labs, research areas and other public spaces (historical facilities, power facilities, prisons, etc.). Adhere to special procedures.

.5 Continuity of Services and Scheduling:

.1 Building:

.1 In use during construction operations. Always maintain existing systems in operation within rooms of building.

.2 Coordinate planned disruption of existing systems and services, duration, one week in advance, with City's Representative.

.2 Disruption of Critical Services:

.1 After hours or weekend working constraints.

.3 Certain Areas of Building:

.1 Access restricted or regulated due to strict environmental control for experimentation, fabrication, and testing or personnel safety. City's Representative: Assist with attempt to identify such areas for advanced scheduling and admittance permission.

.4 Make every effort to minimize disruption and expedite work through coordination and cooperation.

.5 Existing systems and service rooms (such as TRs, electrical rooms, etc.) that are within the immediate proximity of work areas shall be protected from interference, damage, and accidental disconnection of cables, including power, during access to facilities. If any question arises, the City's Representative shall be contacted immediately for inquiry. In case of interference, damage, or accidental disconnection of cables, notify the Construction Manager immediately.

.6 Adjust work schedule in coordination with City's Representative, and coordinate with work of other trades in order to make portions of project available to City as soon as possible.

.7 Be responsible for expenses due to untimely or improperly coordinated work.

1.16 DELIVERY, STORAGE AND HANDLING

.1 Comply with delivery, storage and handling requirements as identified in Division 01 specifications sections and with manufacturer's written instructions.

.2 Develop a bill of materials, perform material management and efficient use of the materials whether they are issued by the City or purchased by the Contractor.

.3 Ensure materials in excess of those required to complete the project are kept in their original condition and packaging for restocking.

.4 Deliver materials to site in original factory packaging labelled with manufacturer's name and address.

.5 Storage and handling requirements:

.6 Store materials indoors in a clean, dry, and well-ventilated location, and in accordance with manufacturer's recommendations.

.7 Store and protect communications equipment from nicks, scratches, and blemishes.

.8 Do not roll or store cable reels without appropriate underlay.

.9 Replace defective or damaged materials with new at no additional cost to the City.

1.17 FIELD REVIEW

.1 The City's Representative will make periodic visits to the site during construction to ascertain reasonable conformity to plans and specifications.

.2 Maintain quality control and be responsible for the execution of work in conformity with the Contract Documents and the requirements of all authorities having jurisdiction. The City's Representative is not responsible for quality control.

.3 The City and City's Representative shall have access to the site at all times for periodic inspections. Maintain a complete set of Contract Documents on site for field reference by the City's Representative.

.4 Provide all equipment necessary for field review by the City's Representative.

.5 Application for final review will be considered when the work has been completed and written declarations submitted that all commissioning, adjustment, set up and documentation is complete. Final review shall be done when:

.1 All reported deficiencies have been corrected.

.2 All systems have been tested, commissioned and are operational.

.3 The City has been instructed in the operation and maintenance of all equipment.

.4 All reports have been submitted and reviewed.

.5 All instruction manuals have been submitted and reviewed.

.6 Cleaning up is finished in all respects.

.7 All spare parts and replacement parts specified have been provided.

.8 All record documents have been submitted and reviewed.

1.18 TRIAL USAGE AND INSTRUCTION TO THE CITY

.1 The City has the privilege of the trial usage of communications systems or parts thereof for the purpose of testing and learning the operational procedures.

.2 Carry out the trial usage over a length of time specified in Contract Documents as deemed reasonable by the City's Representative at no extra cost.

.3 Trial usage shall not be construed as acceptance by the City.

.4 Instruct the City's representative in all aspects of the operation of systems and equipment.

.5 Arrange for and pay for services of service engineers and other manufacturer's representatives required for instruction on specialized portions of the installation.

.6 Submit to the City's Representative at the time of final inspection, a complete list of systems stating for each system:

.1 Date instructions were given to the City's staff.

.2 Duration of instruction.

.3 Name of persons instructed.

.4 Other parties present (manufacturer's representative, Contract Administrators, etc.).

.5 Signature of the City's Representatives stating that they properly understood the system installation, operating and maintenance requirements.

1.19 WARRANTY

.1 Comply with warranty requirements as identified in Division 01 specifications sections.

.2 Submit a written warranty, countersigned, stating that all work executed under this Division will be free from defects of materials and workmanship for a period of one year from the date of final acceptance of this work. Repair and replace all such defective work as well as other work damaged during the process of repair during the warranty period at no cost to the City, except where damage is due to negligence on the part of the City.

.3 Structured cabling system (both copper and optical fibre cabling):

.1 Submit a minimum twenty-five (25) years parts, labour, and application manufacturer warranty. Repair or replace elements of the SCS as required to deliver specified performance of complete system.

.1 Ensure all copper and optical fibre cabling links have been registered with the manufacturer.

.4 Active equipment:

.1 Submit a minimum one (1) year Manufacturer Warranty. Repair or replace active equipment as required to deliver specified performance of each individual component and of the complete system.

.1 Ensure all active equipment requiring registration with the manufacturer are registered prior to substantial completion.

.5 One Year Correction Period:

.1 For period of one year from final acceptance, repair and replacement of defective cabling and/or equipment will commence within 24 hours of first notification.

.2 Complete repairs to equipment within 72 hours. If repairs cannot be completed during this time period or if ordering of parts is required, forward to City's Representative every 72 hours documentation of progress of repairs.

2 Products

2.1 GENERAL

.1 Furnish and install all incidental items not actually shown or specified, but which are required by best practices to provide complete functional systems.

.2 Make, at no additional cost, any changes or additions to materials and/or equipment necessary to accommodate structural conditions (runs around beams, columns, etc.).

2.2 MATERIALS AND EQUIPMENT

.1 Comply with product requirements as identified in Division 01 specifications sections.

.2 All materials and equipment shall be new and unused, clean, and free of defects, damage, and corrosion.

.1 Used or damaged materials and equipment shall not be allowed.

.2 All materials shall be appropriate for the intended use.

.3 Unless otherwise specified, all products shall be standard products of manufacturer.

.4 Ensure equipment and material is certified for use in Canada and bear an identifying stamp or label of the Nationally Recognized Testing Laboratory in Canada (ie CSA, ULC, ETL, etc.).

.3 Contract documents are prepared on basis of acceptable manufacturer(s).

.1 Submit detailed drawings indicating proposed installation if materials and equipment other than specified are proposed.

.1 If Contract Administrator provides additional engineering services as result of substitute materials or equipment by Contractor, or changes by Contractor in dimension, weight, power requirements, etc., of equipment provided, the Contractor shall pay City for cost of such additional services.

.2 If substitution submittal is rejected, revise and resubmit specified equipment that conforms to Contract Documents.

.3 If acceptable manufacturer is no longer available, submit for review equivalent product and/or manufacturer.

.4 Materials and equipment shall be compatible with other items being provided and with existing items to ensure complete and fully operational systems.

2.3 CABLES

.1 Cable passing through two or more floors shall be suitable, listed, and marked for use in riser applications.

.1 Riser cable: FT4 rated per the applicable building code and comply with other applicable codes.

.2 Cable in return-air-plenums shall be suitable, listed, and marked for use in plenum applications.

.1 Plenum cable: FT6 rated per the applicable building code and comply with other applicable codes.

.3 Cable in conduit (or duct) located within a slab-on-grade or below a slab-on-grade, listed, and marked for use in wet applications.

.1 Indoor/Outdoor cable: water blocked and rated per the applicable building code and comply with other applicable codes.

.4 Verify all spaces as plenum, non-plenum, and within or below slab-on-grade with the architect and/or mechanical engineer prior to purchasing or installing any cable.

.5 Be aware of any City or AHJ requirements for plenum cable or other cable types prior to purchasing or installing any cable.

2.4 FACTORY-ASSEMBLED PRODUCTS

.1 Provide maximum standardization of components to reduce spare part requirements.

.2 Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

.1 Components of assembled unit need not be products of same manufacturer.

.2 Alike constituent parts shall be of single manufacturer.

.3 Components shall be compatible with each other and with total assembly for intended service.

.3 Components of equipment shall bear manufacturer's name or trademark, model number and serial number on name plate securely affixed in conspicuous place, or cast integral with, stamped or otherwise permanently marked upon components of equipment.

.4 Equipment that serves same function shall be of same make and model. Exception allowed if performance requirements cannot be met.

2.5 TOOLS AND EQUIPMENT

.1 Miscellaneous Equipment

.1 Provide screws, anchors, clamps, tie wraps, distribution rings, wire molding, miscellaneous grounding and bonding and support hardware, etc., necessary to facilitate installation of communications system(s).

.2 Special Equipment and Tools

.1 Provide special installation equipment or tools necessary to properly complete communications system(s). This may include, but is not limited to, tools for terminating cables, testing equipment for copper/fiber cables, communication devices, jack stands for cable reels, or cable winches.

.3 Lifting Attachments

.1 Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position.

.2 Lifting Attachments shall withstand handling conditions that might be encountered without bending or distortion of shape, such as rapid lowering and braking of load.

2.6 MISCELLANEOUS

.1 Miscellaneous support

.1 Provide clevis hangers, riser clamps, conduit straps, threaded c-clamps with retainers, ceiling trapeze hangers, wall brackets and spring steel clamps as applicable.

.2 Protected with zinc coating or treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic.

.3 Products for Outdoor Applications: Hot dipped galvanized.

.2 Metal fasteners

.1 Zinc-coated (type, grade and class as required).

3 Execution

3.1 GENERAL

.1 Do not scale drawings. Obtain information involving accurate dimensions shown on architectural and structural drawings, or by site measurements. Consult general construction drawings, as well as detail drawings to become familiar with all conditions affecting work and verify spaces in which the work will be installed.

.2 Prior to rough-in, verify exact locations for installation with field measurements and equipment being connected. Drawings do not show all (or any) offsets, fittings, changes in elevation, etc.

.3 Install all ceiling mounted components in accordance with reflected ceiling drawings, approved by the City's Representative.

.4 If field conditions or equipment require significant change to original drawings, contact City's Representative before proceeding.

.5 Methods of construction not specifically described or indicated in Contract Documents subject to control and approval of City's Representative.

.6 Alter, at no additional cost, the location of materials and/or equipment as directed, provided that the changes are made before installation and any such materials and/or equipment is not relocated in excess of 3m (10') in any direction.

.7 Leave space clear and install all work to accommodate future materials and/or equipment as indicated in the Contract Documents, and to accommodate equipment and/or material supplied by another Division of work or Contract. Verify spaces in which work is to be installed. Install all cabling pathways, etc., to maintain headroom and clearances and to conserve space in shafts and ceiling spaces.

.8 Confirm the exact location of outlets/connections for equipment supplied under other Divisions of work or contracts.

.9 Confer with all trades installing equipment which may affect the work of this Division and arrange equipment in proper relation to equipment installed under all Divisions of the Contract.

.10 Timeously furnish all items to be built in, complete with all pertinent information, commensurate with the progress of the work.

.11 Verify dimensions locating work and its relation to existing work (including by other trades), existing conditions and their relation to work and man-made obstructions and conditions, etc. affecting completion and proper execution of work as indicated in Contract Documents.

3.2 EXAMINATION

.1 Comply with existing conditions assessment requirements as identified in Division 02 specifications section(s).

.2 Examination of premises:

.1 Visit site to become familiar with local conditions under which work is to be performed and correlate observations with requirements of Contract Documents.

.2 Verify that conditions of substrate previously installed under other sections or contracts are acceptable for communications equipment installation in accordance with manufacturer's written instructions.

.3 Examine areas and conditions under which system is to be installed. Do not proceed with work until satisfactory conditions have been achieved.

.4 Beginning of installation means installer accepts existing conditions.

.5 No claim for extra payment shall be made for extra work made necessary by circumstances encountered due to conditions which were visible upon, or reasonably inferable from an examination of the site prior to bid submission.

.3 Facility review

.1 Conduct walk-through with City's Representative of work areas, describing specific work methods and proposed schedules, before commencing work, enabling City's Representative to identify areas of concern, desired installation timetables and review important procedural and safety precautions.

.4 Before ordering any materials or doing work, verify measurements and be responsible for correctness of same.

.1 No extra charge or compensation allowed for duplicate work or material required because of unverified difference between actual dimension and measurement indicated on drawings.

.2 Submit discrepancies found in writing to City's Representative for consideration before proceeding with work.

.5 Prior to start of installation, meet at project site with other trades performing related work to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with work. Plan crucial scheduled completions of key rooms and spaces (such as but not limited to equipment room, data center, workstation outlets, and meeting rooms).

3.3 PROTECTION

.1 Protect building and structure from damage due to carrying out this work.

.2 Protect City's facilities, equipment, and materials from dust, dirt, and damage during construction.

.1 Remove protection at completion of work

.3 Protect all communications work from damage. Keep all equipment always dry and clean.

.4 Be responsible for and make good any damage caused directly or indirectly to any walls, floors, ceilings, woodwork, brickwork, finishes, etc.

3.4 ROUGH-IN

.1 Before construction work commences, visit site and identify exact routing for cabling pathways including required core hole locations.

.1 Notify City's Representative of core hole locations that will require asbestos removal or containment prior to proceeding with work.

.2 Coordinate locations with City's Asbestos Management Plan.

.3 Comply with applicable asbestos regulations.

.2 Coordinate equipment locations with other trades, other renovation projects, and existing conditions to eliminate interference with required clearances for equipment maintenance and inspections.

.1 Provide easy, safe, and code mandated clearances at equipment cabinets, racks, enclosures, and other equipment requiring maintenance and operation.

.1 If it is determined that ample maintenance and passage space has not been provided, rearrange work and/or provide other equipment as required for maintenance space.

.2 Coordinate work with other trades and existing conditions to determine exact routing of cabling pathways before fabrication and installation.

.1 Where more than one trade is involved in an area, space or chase, cooperate to utilize space appropriately in relation to individual requirements including required clearances.

.3 Bring to the immediate attention of the City's Representative any changes in size or location of material or equipment necessary to meet field conditions or in order to avoid conflicts between trades.

.4 Verify with City's Representative exact location and mounting height of equipment in finished areas, such as equipment cabinets, racks, and communications devices.

3.5 INSTALLATION

.1 Comply with administrative and product requirements as identified in Division 01 specifications section(s).

.1 Manufactured products, materials, equipment, and components shall be provided, conditioned, applied, installed, connected, and tested in accordance with the manufacturer's specifications and printed instructions.

.2 The installation of all system components shall be carried out under the direction of qualified personnel. Appearance shall be considered as important as mechanical and electrical efficiency. Work quality shall meet or exceed industry standards.

.3 Install materials and equipment in accordance with manufacturers' requirements and/or recommendations. Refer conflicts between manufacturers' requirements and/or recommendations and the Contract Documents to City's Representative for resolution.

.4 Include in the work all requirements of the manufacturer and as shown on the product data sheets.

.5 Install cabinets, racks, equipment, devices, and outlets level and plumb.

.6 Install pathways, dressing and organization of cable plant in neat and well-engineered manner.

.7 Install cabling pathways parallel and perpendicular to the building planes and concealed in chases, behind furring or above ceiling, except in unfinished areas. Install all exposed systems neatly and grouped together, to present a neat appearance.

.8 Install all equipment and apparatus requiring maintenance, adjustment or replacement with sufficient clearance for servicing.

.9 Coordinate ordering and installation of equipment with long lead times or having major impact on work by other trades so as not to delay project or impact schedule.

.10 Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide maximum headroom possible.

.11 Equipment shall not be hidden or covered up prior to observation by City's Representative.

.12 Be responsible for damage to any surfaces or work disrupted as result of the work of this Division. Repair surfaces, including painting. Replace damaged ceiling tiles.

.2 Install cabling in accordance with applicable standards and following manufacturer's design and installation guidelines.

.1 Ensure cable lengths do not exceed applicable codes, acts, regulations, and standards and are in compliance with manufacturer installation instructions and recommendations.

.2 Ensure maximum pulling tensions of specified cables are not exceeded during installation. Cables subjected to pulling tensions exceeding manufacturer's recommended values are considered damaged and are not warranted by the manufacturer.

.3 Ensure minimum bend radii of specified cables are met during and after installation. Cables subjected bend radii not meeting manufacturer's recommended values are considered damaged and are not warranted by the manufacturer.

.4 Protect all cabling from damage during installation, including from being walked / trampled on.

.5 Protect all cabling from paint and/or overspray. Cables impacted by paint and/or overspray are considered damaged and are not warranted by the manufacturer.

.6 Replace damaged cables at no cost to the City. Damaged cables must be replaced end-to-end (splices are not allowed). Provide additional material and labor in timely fashion to properly rectify failure to follow requirements.

.3 Conceal work above ceilings, in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical notify City's Representative before starting that part of work and install only after review by the City's Representative. In areas with no ceilings, install only after City's Representative's review.

.4 Comply with cutting and patching requirements as indicated in Division 01 specifications section(s).

.5 Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support contract work.

.1 Provide approved supports.

.2 Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above.

.3 Support communications work from precast panels/planks and metal decks as determined by the manufacturer and the City's Representative.

.6 Design and install cable pathways such that cabling and associated equipment do not interfere with operation or maintenance of other equipment.

.1 Support cabling from approved telecommunications raceways only.

.2 Install cabling in accessible spaces for ease of access.

.3 Install cabling pathways above suspended ceilings, within mechanical rooms, closets, and other similar spaces such that cabling pathways are not blocked or covered in a way to impede the addition of cabling in the future.

.7 Power separation

.1 Do not place communications cabling alongside power cabling, or share same conduit, channel or sleeve with electrical apparatus. Ensure separation distance between communications and electrical cabling is compliant with applicable codes and standards.

.8 Replace any work unsatisfactory to the Contract Administrator or City's Representative without extra cost to the City.

3.6 EQUIPMENT AND CABLING SUPPORTS, ANCHORS AND HANGERS

.1 Provide all supports required for the erection and support of the communications work.

.2 Suspend all hangers directly from the structure using approved inserts or beam clamps.

.3 Do not use pipe hooks, or perforated straps.

.4 Support backbone cabling installed in a riser, shaft, or in a vertically installed conduit. Support the cable(s) at the top of the run and at regular intervals throughout the length of the cable as determined by the maximum vertical rise distance per manufacturer requirements for the cable being installed. Use cable manufacturer approved cable supports such clamps, mesh basket grip (kellum grip), etc.

.5 Where non-continuous cabling pathways (j-hooks and/or cable slings) are allowed, space the supports at no more than 1.5 m (5 ft) apart.

.6 Do not support any cabling or cabling pathways from drop-ceiling (t-bar) support wires, ductwork, pipes, etc.

3.7 PENETRATIONS

.1 Seal foundation penetrations by communications conduits and sleeves to eliminate intrusion of moisture and gases into building in compliance with applicable codes and standards and as identified in Division 07 specification section(s).

.1 Plug spare conduits with expandable plugs.

.2 Seal or reseal service entrance conduits upon cable placement.

.3 Permanently seal conduits with cable(s) by firmly packing void around cable(s) with oakum and capping with hydraulic cement or waterproof duct seal.

3.8 FIRESTOPPING

.1 Firestop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with applicable codes and standards and as identified in Division 07 specification section(s).

.1 For new penetrations:

.1 Provide only prefabricated firestop sleeve solution where cable(s) penetrate fire rated walls, floors, partitions and ceilings to ensure that the fire rating is maintained.

.1 Penetrations through fire rated walls, floors, partitions and ceilings to accommodate cable tray (of any type) shall not be permitted, including with the use of fire stop pillows. Cable tray must stop proud of walls, floors, partitions and ceilings to allow cabling to transition from tray to prefabricated firestop sleeves.

.2 For existing penetrations:

.1 Provide firestop pillows for sealing existing cable tray penetrations through firewall.

.3 For conduit and conduit sleeve penetrations:

.1 Provide a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty fire-stop system along with appropriate damming or backer materials inside conduits.

.1 Putty shall be capable of being removed and reinstalled.

.2 Patch openings remaining around and inside conduit and sleeves penetrations to maintain integrity of fire rated assembly.

.1 Sealant shall adhere to penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

.2 Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, Authorities Having Jurisdiction and others the manufacturer of the device and the corresponding ULC System number installed.

3.9 PROJECT PHOTOGRAPHS

.1 Create a photographic record of cabling pathways prior to concealment of interior and exterior cabling pathways:

.1 Take photographs at locations such that the entire length of pathway is captured in photograph.

.2 Take photographs of underground pathways prior to concrete pour and again prior to backfill.

.3 Take photographs of interior maintenance hole wall elevations.

.4 Take photographs of other installations or situations as required by the City's Representative.

3.10 FIELD QUALITY CONTROL

.1 Comply with testing and inspection services requirements as identified in Division 01 specifications section(s) and in this Division.

.1 Provide promptly the facilities, labour, and material reasonably needed for performing such safe and convenient inspections and tests as required by the Contract Documents.

.2 City's Representative may inspect and perform tests prior to final acceptance.

.1 Inspections and tests shall be performed in a manner to not unnecessarily delay work.

.2 Assist the City with these inspections as well as functionality and performance tests as required.

.3 Failure of systems or subsystems to perform as specified shall be considered as a failure to comply with requirements of the Contract Documents.

3.11 USE OF CABLE PRIOR TO ACCEPTANCE

.1 Permit City to place and install cross connects, patch cords and/or equipment onto wire or cable installed under this contract, prior to Substantial Completion.

.1 Such placement or installation shall not be construed as evidence of completion of work nor signify City's acceptance of work.

.2 City shall be responsible for any damages caused by their work forces due to temporary connection to new cable plant before final acceptance.

.3 Wire, cabling, and equipment provided, whether work of Contractor is partially or fully completed or not, shall be property of the City. The City retains certain rights and privileges in connection with their use.

3.12 CLEANING

.1 Comply with cleaning requirements as identified in Division 01 specifications section(s).

.1 Keep site and surrounding area free from accumulation of waste materials and rubbish on daily basis.

.2 Keep communications equipment and fixtures clean for duration of project. Comply with applicable regulations regarding facilities and environmental extreme cleanliness.

.3 Prior to equipment activation, ensure final cleaning is completed to the satisfaction of the City's Representative.

.1 Clean all cabinets, racks, and equipment. Polish all plated surfaces.

.2 Remove all temporary protection and covers.

.3 Ensure all communications spaces are free from debris and dust.

.4 Leave communications work in asnew working order.

.4 The City reserves the right to re-call the Contractor back to perform cleanup. If Contractor fails to perform cleanup another contractor will be engaged at contractor's expense to perform cleanup.

3.13 CUTOVER, GO-LIVE SUPPORT, AND SUPPORT

.1 Cutover

.1 Provide minimum of two technicians onsite for total of 40 hours each to assist as required with system(s) activation.

.2 Activities include, but are not limited to:

.1 Setup/Device Placement and testing.

.2 Placement of additional patch cables and additional cross connects.

.3 Troubleshooting of installed cable plant.

.4 Trouble ticket resolution.

.2 Go-Live Support:

.1 Provide one person for one day (8 hours) beginning with first scheduled go-live date.

.2 For a period of one week after this day, provide necessary support to assure two-hour response time to issues arising from work identified by City's Representative.

3.14 START-UP, CARE, AND MAINTENANCE

.1 Instruct City's Representative and City's personnel in the start-up, care, and maintenance of equipment.

.1 Care, start-up, and maintenance training includes but is not limited to:

.1 Physical review of installation.

.2 Review of record documentation and test results.

.3 Functional review and training of all systems.

.4 Care and maintenance requirements of all systems.

.5 Additional City requirements defined during project.

.2 Arrange and pay for services of manufacturer(s) factory service engineer(s) to supervise start-up of installation, and to check, adjust, balance and calibrate components.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that City's personnel are conversant with all aspects of equipment start-up, care, and maintenance.

3.15 DEMONSTRATION AND OPERATION TRAINING

.1 Comply with demonstration and training requirements as identified in Division 01 specifications section(s).

.1 Provide a minimum of 24 hours of demonstration and training of City's personnel.

.2 Demonstration and training include but is not limited to:

.1 Functional review and training of all systems.

.2 Additional City requirements defined during project.

.3 Provide demonstration and training until all applicable members of City's staff are confident in the use and operation of all systems.

END OF SECTION

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 01 33 00 – Submittal Procedures.

.3 Section 01 40 00 – Quality Requirements.

.4 Section 01 61 00 - Common Product Requirements.

.5 Section 01 74 00 – Cleaning and Waste Processing.

.6 Section 01 78 00 – Closeout Submittals.

.7 Section 01 79 00 – Demonstration and Training.

.8 Section 01 91 00 – General Commissioning Requirements.

.9 Section 26 05 00 – Basic Electrical Materials and Methods.

.10 Section 26 05 27 – Grounding - Primary.

.11 Section 26 05 28 – Building Grounding.

.12 Section 27 05 00 – Common Work Results for Communications.

1.2 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/Telecommunications Industries Association (TIA)

.1 ANSI/TIA-607 (latest version) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

.2 ANSI/TIA-606 (latest version) Administration Standard for Telecommunications Infrastructure.

.2 The Contractor shall perform all work according to Federal, Provincial, and Municipal codes, rules, regulations, and ordinances governing the work, and as fully part of the specifications as if herein repeated or hereto attached.

.3 This document does not replace any code, either partially or wholly. The Contractor must be aware of local codes that may impact this project.

.4 If the Contractor should note items in the drawings or the specifications, construction of which would be code violations, promptly call them to the attention of the City's representative in writing.

.5 All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

.6 In the event of conflict, the most stringent and recent requirements shall apply to the codes and standards above.

1.3 SYSTEM DESCRIPTION

.1 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are to be bonded to telecommunications grounding and bonding system.

.2 All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labelled, and documented by the Contractor as detailed in this Section.

.3 Product specifications, general design considerations and installation guidelines are provided in this Section.

.4 The Contractor shall meet or exceed all requirements for the cable system described in this Section.

.5 Local electrical codes shall be adhered to.

.6 Local building codes shall be adhered to.

.7 All communications components including, entrance lugs, entrance terminal frames, racks, cabinets, cable tray, ladder racks, metallic pathways, enclosures and other components noted on drawings shall be bonded to an independent grounding system and in accordance with local codes and standards, ANSI/TIA-607 (latest version), and IEEE Std. 1100 and these specifications.

.8 Grounding system shall include a local copper Secondary Bonding Busbar (SBB) (by Division 26) in Electrical Room bonded to a Telecommunications Bonding Backbone (by Division 26).

.9 The SBB shall be bonded directly to the Primary Bonding Busbar (by Division 26).

.10 The grounding system shall be visually verifiable and adequately sized to handle expected currents safely.

.11 All grounding conductors and busbars shall be made of copper.

.12 The grounding system shall be intentional, visually verifiable, adequately sized to handle expected currents safely, and direct these currents away from network equipment. As such, grounding shall be purposeful in its design and installation.

.13 Lugs, HTAPs, grounding strips, and busbars shall be UL Listed and CSA certified and made of premium quality tin-plated electrolytic copper that provides low electrical resistance while inhibiting corrosion. Antioxidant shall be used when making bonding connections in the field.

.14 Wherever possible, two-hole lugs shall be used. All lugs shall be irreversible compression and meet NEBS Level 3. Lugs with inspection windows shall be used in all non-corrosive environments so that connections may be inspected for full conductor insertion (battery rooms are an exception where windowless lugs may be used).

.15 Die index numbers shall be embossed on all compression connections to allow crimp inspection.

.16 Cable assemblies shall be UL Listed and CSA Certified. Cables shall be a distinctive green or green/yellow in color, and all jackets shall be UL, VW-1 flame rated.

.17 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors, as applicable to this project.

.18 Provides ground reference for telecommunications systems within building.

.19 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

1.4 SUBMITTALS

.1 Shop Drawings: Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit Commissioning forms in accordance with Section 01 91 00 – General Commissioning Requirements with Manufacturer's/Contractor's forms appended.

.3 Submit Operation and Maintenance (O&M) Data for all equipment in this Section in accordance with Section 01 78 00 – Closeout Submittals. Include insulating liquid maintenance data.

1.5 ABBREVIATIONS

.1 The following abbreviations are excerpted from the ANSI/TIA-607 standard entitled: Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises:

.1 PBB – Primary Bonding Busbar

.2 SBB – Secondary Bonding Busbar

.3 TBB – Telecommunications Bonding Backbone

.4 RBB – Rack Bonding Busbar

.5 TBC – Telecommunications Bonding Conductor

.6 BBC – Backbone Bonding Conductor

1.6 QUALITY ASSURANCE AND CONTROL

.1 Refer to Section 01 40 00 – Quality Control.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Health and Safety specifications.

2 PRODUCTS

2.1 PRIMARY BONDING BUSBAR (PBB)

.1 The PBB shall be 6mm (1/4 inch) thick and 102mm (4 inches) wide and red stand-off 70mm (2.75 inches) from the backboard or wall.

.2 The PBB shall be available in standard lengths of 305mm (12 inches) or 508mm (20 inches).

.1 Each 305mm (12 inch) PBB shall include a minimum of (12) 6mm (1/4 inch) with 16mm (5/8”) spacing and (6) 10mm (3/8” inch) with 25mm (1”) spacing holes.

.2 Each 508mm (20 inch) PBB shall include a minimum of (24) 19mm (3/4 inch) with 16mm (5/8”) spacing and (6) 10mm (3/8 inch) with 25mm (1”) spacing holes.

.3 Each PBB shall accept any lug with a 10mm (3/8”) bolt

2.2 SECONDARY BONDING BUSBAR (SBB)

.1 See electrical grounding busbar under Section 26 05 28 – Grounding – Secondary.

.2 The SBB shall be 6mm (1/4 inch) thick and 51mm (2 inches) wide and red stand-off 70mm (2.75) inches from the backboard or wall.

.3 The SBB shall be available in standard lengths of 254mm (10 inches), 305mm (12 inches) or 508mm (20 inches).

.1 Each 254mm (10 inch) SBB shall include a minimum of (4) 6mm (1/4 inch) with 16mm (5/8”) spacing and (3) 10mm (3/8) inch with 25mm (1”) spacing holes.

.2 Each 305mm (12 inch) SBB shall include a minimum of (6) 6mm (1/4 inch) with 16mm (5/8”) spacing and (3) 10mm (3/8 inch) with 25mm (1”) spacing holes.

.3 Each 508mm (20 inch) SBB shall include a minimum of (12) 6mm (1/4 inch) with 16mm (5/8”) spacing and (3) 10mm (3/8 inch) with 25mm (1”) spacing holes.

.4 Each SBB shall accept any lug with a 10mm (3/8”) bolt.

2.3 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

.1 Cable assemblies shall be UL Listed and CSA Certified and be a minimum of 6 AWG copper conductor, green insulated.

.2 Telecommunications Grounding and Bonding Conductor Label Kits shall be supplied and installed by the Electrical Contractor at every rack and cabinet as well as one for every Secondary Bonding Busbar.

.3 The bonding conductor size shall be as follows:

TBB Length in Linear Metres Metres (Feet)	TBB Size (AWG)
Less than 4 (13)	6
4-6 (14-20)	4

6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
20-26 (67-84)	3/0

2.4 TELECOMMUNICATIONS BONDING CONDUCTOR (TBC)

.1 Cable assemblies shall be UL Listed and CSA Certified and be a minimum, the same size as the largest TBB copper conductor.

.2 Shall be green insulated and marked in accordance with ANSI/TIA-607.

2.5 RACK BONDING BUSBAR (RBB)

.1 Vertical Rack-Mounted Busbar

.1 Vertical rack busbars provide a vertical ground continuity path between equipment along an equipment rack or cabinet face.

.2 Vertical rack busbars shall be constructed of electro-tin plated hard-drawn electrolytic tough pitch solid copper.

.3 Each vertical rack-mounted busbar shall be 16mm (5/8 inch) wide and 6mm (1/4 inch) thick.

.4 Vertical rack-mounted busbars shall bond a minimum of 45 standard EIA/ TIA rack units (RU) and shall include pairs of #1/4-20 tapped mounting holes on 16mm (5/8 inch) centers.

.5 Vertical rack-mounted busbars shall have standard lengths of 914mm (36 inches) and 1829mm (72 inches).

.6 Vertical rack-mounted busbars shall accept a minimum of one set of #5/16 self-clinching studs on 25mm (1 inch) centers at both ends for attachment of a ground conductor.

.2 Horizontal Rack-Mounted Busbar

.1 Horizontal rack busbars shall be constructed for installation on 483mm (19”), 584mm (23”), or 889mm (35”) standard equipment racks and cabinets that meet EIA-310-D.

.2 Horizontal rack busbars will be 5mm (3/16 inch) thick and 19mm (3/4 inch) wide.

.3 Horizontal rack busbars shall include a minimum of eight #6-32 tapped lug mounting holes on 25mm (1 inch) centers and two pairs of 8mm (5/16 inch) diameter holes spaced 16mm (5/8 inch) apart for attaching ground jumpers.

2.6 MATERIALS

.1 Cable Runway Ground Strap

.1 General:

.1 Cable runway ground straps provide a ground pathway between cable pathway segments/ runway lengths when fastened together across pathway/ runway splices.

.2 Cable runway ground straps shall be constructed of UL Listed components.

.2 Size:

.1 Each cable runway ground strap shall consist of a minimum 8-inch long #6 AWG green/ yellow insulated stranded copper conductor attached at both ends to two-hole compression lugs.

.2 Each compression lug at each end of the conductor shall include two 6mm (1/4 inch) bolt holes spaced on 16mm (5/8 inch) centers.

.2 Ground Jumper

.1 Ground Jumpers provide common grounding from the equipment, equipment rack or cabinet to the halo conductor, grounding strip or grounding busbar.

.2 Ground Jumpers shall be constructed of minimum #6 AWG green/ yellow insulated stranded copper conductor attached to a compression lug at each end.

.3 Each compression lug at each end of the conductor shall include two 6mm (1/4 inch) bolt holes spaced on 16mm (5/8 inch) centers. Compression lugs shall be available with 90° and 45° angles.

.4 Ground jumper shall be available in 610mm (2-foot), 914mm (3-foot), and 2743mm (9-foot) lengths.

.5 Constructed of UL Listed components.

.3 Two Mounting Hole Ground Terminal Block

.1 Terminal blocks shall provide a method for attaching ground wires to racks or cabinets.

.2 Terminal blocks shall be constructed of extruded, high-strength aluminum.

.3 Terminal blocks shall accept conductors from #14 AWG through 2/0 AWG.

.4 Each terminal block shall include two #3/8-24 x 22mm (7/8 inch) stainless steel hex head set screws.

.5 Terminal blocks shall be UL Listed and meet BICSI and ANSI/EIA/TIA two hole mounting recommendations.

.4 Code/Flex Conductor Tap

.1 Code/ Flex conductor taps shall be provided a method for tapping into continuous conductors as a splice or pigtail.

.2 Each tap shall support #6 - #10 AWG, #2 - #6 AWG, 250 kcmil - #2 AWG, and 4/0 - #2 AWG run and #2 - #6 AWG, #2 - #8 AWG, and #8 - #14 AWG taps.

.3 Each tap groove shall be constructed separately from one another to allow each groove to function independently of one another.

.4 Taps shall be UL Listed and CSA Certified with AWG conductors for applications up to 600V.

.5 Clear high impact plastic covers shall be provided with each tap and shall meet the following requirements:

.1 Each cover shall allow complete 360° inspection of the crimp connection to assure that the crimp was made properly.

.2 Each cover shall allow labels to be added to and protected by either side of the cover.

.3 Each cover shall include molded flash barriers encompassing the tap and crimp to provide protection against electrical flash over.

.4 The high impact plastic shall meet the UL 94V-0 flame rating and oxygen index of 28 providing self extinguishing, flame retardant properties.

.5 Each cover shall include the part number, voltage rating, and temperature rating molded into the cover.

.5 U-bolt Style Grounding Clamp

.1 U-bolt style grounding clamps shall provide a method to ground copper conductors to rods, tubes or pipes at parallel or right angle.

.2 Clamps shall be constructed from high strength, electrolytic cast bronze.

.3 Clamps hardware shall be constructed from high strength silicon bronze hardware.

.4 Clamps shall be UL Listed for grounding and bonding with AWG conductors and suitable for direct burial in earth or concrete.

.5 U-bolt clamps shall accept the following pipe sizes: 16mm (1/2”), 21mm (3/4”), 27mm (1”) and the following ground rod sizes: 7/8” and 27mm (1”).

.6 U-bolt clamps shall accept the following conductor sizes: #8 SOL - #4 STD AWG and #4 SOL – 3/0 STD AWG

2.7 WARNING LABELS

.1 Non-metallic warning labels in English and French to ANSI/TIA-607.

3 EXECUTION

3.1 GENERAL

.1 The grounding and bonding system shall provide equipment ground connections (bonds) from the premises entrance facility and outside-plant grounding system to each telecommunication room telecommunication ground busbar, through the racking systems to bond the network equipment.

.2 The entire grounding link from equipment to earth should be visually verifiable except where hidden by walls, conduit or pathways.

.3 The Contractor shall ensure that all elements of the communications bonding network are labelled according to guidelines defined in ANSI/TIA-607 and ANSI/TIA 606.

3.2 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

.1 Bonding and grounding conductors may be insulated or un-insulated and shall not decrease in size as the grounding path moves closer to earth.

.2 Connections (bonds) between the telecommunications grounding network and associated electrical panels shall be done by a qualified electrician in accordance with guidelines in ANSI/ANSI/TIA 607 and applicable electrical codes.

.3 Bonding Conductors should be continuous and routed in the shortest possible straight line path, avoiding changes in elevation and sharp bends.

.4 TBB conductors shall be protected from mechanical damage and built so as to minimize splicing. Where splicing is unavoidable they shall be done using irreversible compression splices (C-TAPS) built to that purpose. See the "Materials" section of this document for appropriate compression splices.

.5 Routing grounding conductors through ferrous metal conduit should be avoided, but if it is necessary due to building constraints, any grounding conductor running through ferrous conduit longer than 3 feet shall be bonded at the end using appropriately sized HTAP and Conduit grounding clamps as described ANSI/TIA 607 -Busing appliances described for that purpose in the "Materials" section of this document.

.6 Conductors used to bond TBB to conduit ends shall be of #6 AWG size or larger.

3.3 CUTTING, PATCHING AND REPAIRING

.1 Racks and Cabinets shall be bonded into the communications bonding network with conductors of #6 AWG or larger.

.2 Racks and cabinets shall have individual Rack Bonding Conductors (RBC) bonding to the Rack Bonding Busbar (RBB) or underfloor Supplemental Bonding Grid.

.3 In smaller Telecommunications Rooms (3-5 racks) it is acceptable to have Rack Bonding Busbar (RBB) that go directly from each individual rack to the SBB.

.4 Rack Bonding Conductors (RBC) or Rack Bonding Busbar (RBB) shall be installed to maintain a minimum of 51mm (2") separation from all other types of cable - power or communications.

.5 Depending on size of the telecommunications room, Rack Bonding Conductors (RBC) may tap into underfloor or overhead grounding conductors, or for smaller TRs (3-5 racks or cabinets), may go directly from the rack to the wall mounted busbar.

.6 Racks, cabinets and similar enclosures shall not be attached serially (daisy-chained) but must have individual RBC into the grounding system.

.7 Newly installed racks and cabinets shall have vertical grounding busbars installed along one rail to provide clean bonding landing point for all rack mount equipment. Grounding busbars shall not be isolated from the rack or cabinet.

.8 All painted components of racks/cabinets shall be assembled using serrated grounding washers and thread-forming screws to ensure electrical continuity between the different structural components of the rack/cabinet.

.9 Larger equipment (chassis switches) with integral grounding terminals or pads shall be bonded to the vertical busbar with equipment grounding kits attached to those terminals and bonding them to the rack-mounted busbars.

.10 Anywhere two metallic surfaces are to be bonded, contractor shall clean the contact areas of paint or oxidation using abrasive pads, and apply film of anti-oxidation compound between surfaces prior to bonding.

.11 All cable fittings shall be of two-hole (LCC series) compression-type. Mechanical screw-lugs on racking systems will not be accepted and must be removed and replaced at contractor's expense.

.12 All screws used to affix compression lugs to rack-mounted vertical busbars shall be of the thread forming type made specifically for electrical bonding.

.13 Smaller equipment (servers, TOR switches) not having integral grounding pads must be bonded to the rack through the equipment mounting flanges using green thread-forming grounding screws with serrations under the head to cut through paint, coatings and oxidation that may be present on the equipment flange. Such equipment shall have minimally one grounding screw per piece of equipment.

.14 ESD (electro-static discharge) ports and wrist straps shall be provided minimally every other rack or bay to be within reach of any active equipment. On larger 4-post racks or cabinets - ESD ports and wrist straps shall be installed on the front and back to be accessible when servicing any active equipment.

.15 All Contractor personnel servicing active equipment must be wearing a properly grounded wrist strap to dissipate ESD charges prior to touching any active equipment.

3.4 INSTALLATION AND INSPECTION - GENERAL

.1 The equipment/products shall be installed as indicated on the Contract Drawings and these specifications, in accordance with the Manufacturer’s recommendations and as approved by the Contract Administrator.

.2 Provide the services of a factory trained representative(s) to inspect, operate, test, adjust, and troubleshoot the installations.

.3 Inspection to include checking for:

.1 Cracks and other damaged or defective parts. Each equipment/product, as well as accessories, must be undamaged, without cracks and free of defective parts.

.2 Completeness of installation as specified and as recommended by the Manufacturer.

.3 Correctness of setting, alignment and relative arrangement of various parts of the system.

.4 Provide for additional supervision of installation by Equipment Manufacturer as required. Arrange with the Contract Administrator a mutually agreeable date when the representative should be on site.

.5 Complete on-site testing (and off-site testing where specified), and provide the results of the tests, all in accordance with Section 01 11 00 – Summary of Work.

.6 Submit a report, signed by the Manufacturer's representative, describing in detail the inspection, tests, and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verify that the equipment/products conform to all specifications.

3.5 SUPERVISION OF INSTALLATION AND COMMISSIONING - GENERAL

.1 Provide commissioning and startup in accordance with Section 01 91 00 – Commissioning and these specifications.

.2 At the completion of satisfactory installation, each unit shall be started by the Contractor under the supervision of the Manufacturer and in conjunction with plant operating conditions.

.3 Equipment/products shall only be accepted after receipt of a satisfactory report submitted by the Manufacturer's representatives.

.4 Modify or replace equipment/products failing required tests.

.5 Perform additional testing required due to changes of equipment/products and/or failure of equipment/products or construction to meet specifications at no extra cost to the City.

3.6 PERFORMANCE TESTS - GENERAL

.1 Complete on-site testing (and off-site testing where specified) and provide the results of the tests, all in accordance with Section 01 11 00 – Summary of Work and these specifications.

.2 The field service representative(s) shall submit to the Contract Administrator a written report stating that the equipment/products have been checked and is suitable for operation.

3.7 STORAGE

.1 Prior to installation, the equipment/products and accessories shall be protected and stored indoors in a dry area, in accordance with the Manufacturer's recommendations.

3.8 OPERATION AND MAINTENANCE (O&M) DATA

.1 Submit Operation and Maintenance (O&M) Data for all equipment/products in this Section in accordance with Section 01 78 00 – Closeout Submittals.

3.9 TRAINING

.1 Unless otherwise specified, provide Demonstration and Training in accordance with Section 01 79 00 – Demonstration and Training.

3.10 BONDING GENERAL

.1 When placed in ferrous metallic conduit or EMT longer than 1 m, bond to each end of conduit or EMT using 6AWG copper conductor.

.2 Outdoor grounding and bonding connections.

.1 All outdoor grounding and bonding (earthing) connections shall be accomplished using exothermic welding.

.3 Rack-Mount Busbars and Ground Bars

.1 Add a rack-mount horizontal or vertical busbar or ground bar to the cabinet. The rack-mount busbar or ground bar provides multiple bonding points on the cabinet for cabinet and rack-mount equipment.

.2 Attach rack-mount busbars and ground bars to racks or cabinets according to the manufacturer's installation instructions.

.3 Bond the rack-mount busbar or ground bar to the room's main grounding busbar with appropriately sized hardware and conductor.

.4 Minimum bonding connection to cabinets shall be made with a rackmount two-hole ground terminal block sized to fit the conductor and cabinet and installed according to manufacturer recommendations.

.5 Remove paint between cabinet and terminal block, clean surface and use antioxidant between the cabinet and the terminal block to help prevent corrosion at the bond.

.4 Bonding Conductor for Telecommunications

.1 Install bonding conductor for telecommunications from communications rack to service equipment (power) ground.

.2 Use exothermic welding, 2-hole non-twisting lugs for connection to electrical grounding busbar.

3.11 LABELLING

.1 Apply warning labels to telecommunications bonding and grounding conductors.

.2 Apply additional administrative labels to: TIA/EIA-606.

END OF SECTION

1 General

1.1 INTRODUCTION

.1 Information and Communication Technology (ICT) systems require specific pathway and design construction practices. This section specifies the pathway infrastructure to be installed, based on the ANSI/TIA-569 (latest version) standard: "Commercial Building Standard for Telecommunications Pathways and Spaces."

.2 An empty telecommunications pathway system consists of outlet boxes, cover plates, wire basket trays, conduits, pull boxes, junction boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts, modular poke-throughs.

.3 A wire basket tray system will be utilized in data closets for cable distribution.

.4 A conduit system shall be installed for backbone cabling and horizontal cabling in open and inaccessible ceiling spaces, in accordance with these Division 26 Electrical Specifications.

.5 A J-hook system shall be installed for interior areas with accessible ceiling tiles for horizontal cables branching out to communications outlet device locations.

.6 Conduits shall be rated per area by building classification.

.7 If there are any questions, please contact the Contract Administration for clarification.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 01 33 00 – Submittal Procedures.

.3 Section 01 45 00 – Quality Control.

.4 Section 01 61 00 - Common Product Requirements.

.5 Section 01 74 00 – Cleaning and Waste Processing.

.6 Section 01 78 00 – Closeout Submittals.

.7 Section 01 79 00 – Demonstration and Training.

.8 Section 01 91 00 – Commissioning.

.9 Section 26 05 00 – Basic Electrical Materials and Methods.

.10 Section 26 05 27 – Grounding - Primary.

.11 Section 26 05 28 – Building Grounding.

.12 Section 26 05 19 – Low Voltage Conductors

.13 Section 26 20 00 – Electric Service and Distribution.

.14 Section 26 05 36 – Cable Trays.

.15 Section 26 27 26 – Wiring Devices.

.16 Section 26 27 28 – Service Floor Boxes.

.17 Section 27 05 00 – Common Work Results for Communications.

.18 Section 27 05 26 - Grounding and Bonding for Communications Systems.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.1 No.126.1-02, Metal Cable Tray Systems.

.2 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.

.3 CSA C22.2 No. 45, Rigid Metal Conduit.

.4 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.5 CSA C22.2 No. 83, Electrical Metallic Tubing.

.6 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.

.7 CAN/CSA C22.2 No. 227.3-05, Non-metallic Mechanical Protection Tubing (NMPT), A National Standard of Canada

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA FG 1, Fibreglass and Cable Tray Systems.

.2 NEMA VE 1, Metal Cable Tray Systems.

.3 NEMA VE 2, Cable Tray Installation Guidelines.

.3 TIA/EIA, Latest version:

.1 TIA/EIA-568 Series Commercial Building Telecommunications Cabling Standard.

.2 TIA/EIA-569 Commercial Building Standard for Telecommunications Pathway and Spaces.

.3 TIA/EIA-606 Administration Standard for Commercial Telecommunications Infrastructure.

.4 TIA/EIA-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

.5 TIA/EIA-758 Customer Owned Outside Plant Telecommunications Cabling Standard.

.6 TIA/TSB-184 Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling

.4 BICSI, Latest version:

.1 BICSI - Outside Plant Design Reference Manual.

.2 BICSI – Telecommunication Distribution Methods Manual.

.3 BICSI – Information Transport System Installation.

.4 BICSI – Network Design Reference Manual.

.5 ANSI/BICSI 005-2016 Electronic Safety and Security (ESS) System Design and Implementation Best Practices

.5 Local Codes and Standards – all applicable

.6 Local Authority Having Jurisdiction (AHJ)

.7 This document does not replace any code, either partially or wholly. The Contractor must be aware of local codes that may impact this project.

.8 If the Contractor should note items in the drawings or the specifications, construction of which would be code violations, promptly call them to the attention of the Contract Administrator in writing.

.9 All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

.10 In the event of conflict, the most stringent and recent requirements shall apply to the codes and standards above.

1.4 INDOOR CABLE DISTRIBUTION

.1 Ensure ANSI/TIA-568 installation practices are followed for all indoor cable distribution.

.2 The Contractor shall install and distribute cabling using sleeves, conduit, communications cable tray as indicated on drawings and as supplied and installed by Division 26.

1.5 SUBMITTALS

.1 Shop Drawings: Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures and Section 26 05 01 – Common Work Results - Electrical.

.2 Submit Commissioning forms in accordance with Section 01 91 00 – Commissioning with Manufacturer's/Contractor's forms appended.

.3 Submit Operation and Maintenance (O&M) Data for all equipment in this Section in accordance with Section 01 78 00 – Closeout Submittals. Include insulating liquid maintenance data.

1.6 QUALITY CONTROL

.1 Refer to Section 01 45 00 – Quality Control.

2 Products

2.1 CONDUIT

.1 Refer to Section 26 05 00 – Basic Electrical Materials and Methods.

.2 The minimum trade size is 27mm (1").

2.2 J-HOOK

.1 Refer to Section 26 05 00 – Basic Electrical Materials and Methods.

.2 Provide J-Hook system components that are plenum-rated (regardless of whether air plenum ceilings exist on the project). Provide J-Hooks, not Cable Fasteners, and not Bridle Rings. Provide open-top hooks, so cables can be laid into the J-Hooks rather than threaded through. Provide tool-less cable retainer clips (do not use cable ties). Provide hooks sized for maximum 40% fill (in cross section) based on outside diameter of cables. Accordingly, provide multiple sets of J- Hooks along any given pathway as applicable.

.3 Provide steel units with rolled hook edges to prevent damage to cable jackets and insulation.

.4 Cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish, ASTM B633, SC3.

.5 Cable hooks for corrosive areas shall be stainless steel, AISI Type 304.

.6 Provide necessary factory hooks, cable retainers, fasteners, attachment kits, etc. as required for complete installations.

.7 Typical J-hook size and cable capacity:

	CAT6A
27mm (1") (Size 16)	10
35mm (1 5/16") (Size 21)	25
53mm (2") (Size 32)	35
78mm (3") (Size 48)	80
103mm (4") (Size 64)	140

.8 Approved manufacturer:

.1 Caddy CableCat

.2 Chatsworth Products, Inc.

.3 Eaton Cooper B-Line

.4 Snake Tray by Cable Management Solutions, Inc.

.5 Approved equal.

2.3 CABLE TRAYS

.1 Refer to Section 26 05 36 – Cable Trays for Electrical Systems.

.2 Type: Wire mesh basket cable tray.

.3 The cable tray in the Data Closets will be 410mm (16”) (Width) x 100mm (4”) (Height).

.4 Approved manufacturer:

.1 WBT

.2 CER

.3 Flex Tray

.4 Approved equal.

2.4 CONDUIT FITTINGS

.1 Fittings for electrical metallic tubing shall be single screw indenter fittings for conduits up to 53mm (2") and double screw indenter fittings for conduits 53mm (2") and larger.

.2 Die-cast or pressure cast fittings are not permitted.

.3 Connectors shall have insulated throat up to and including 27mm (1") size. For sizes 35mm (1-1/4") and larger, provide plastic insulating bushing.

.4 Provide conduit body types, shapes and sizes as required to suit application, CEC and Category 6A cable blend radius requirements. Provide matching gasket covers secured with corrosion-resistant screws.

2.5 EXPANSION FITTINGS

.1 Provide expansion fittings with external grounding straps at building expansion joints.

.2 Minimum 4” movement in either direction.

.3 At expansion joints in concrete pours, provide deflection/expansion fittings capable of movement of 21mm (¾”) in all directions from the normal.

2.6 WATER PROOFING SEALS

.1 Provide watertight expanding link-type seals for installation between the conduit and the sleeve or core drilled hole.

2.7 JUNCTION BOX

.1 For standard non chemically hazardous environments junction boxes shall be constructed of not less than 14-gauge pre-galvanized steel with trim for flush or surface mounting in accordance with the location to be installed. All junction boxes in public spaces; they have to be lockable.

.2 Provide screw-on type cover boxes installed in damp or wet locations shall be of rain-tight construction with gasketed cover and threaded conduit hubs.

.3 Boxes shall be NEMA approved for the environmental condition of the location where they will be installed.

.4 Junction box size shall maintain Category 6A UTP cable bend radius requirement.

2.8 PULL CORD

.1 All new conduits shall be equipped with a pull cord that has a minimum test rating of ≈90 kg (200 lb).

2.9 FIRE RATED PATHWAY (FIRE-STOPPING)

.1 A fire-stop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.

.2 Fire-stop systems in commercial premises shall meet the requirements of ANSI/TIA-569.

.3 Fire stop systems should be designed to be compatible with the worst-case environment to which they will be exposed (refer to ANSI/TIA-568.0 for information on environmental classifications).

.4 All data, video, and communications cable bundles shall utilize an enclosed fire-rated pathway device wherever said cables penetrate rated walls.

.5 The fire rated pathway shall contain a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated.

.6 The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to remove or reinstall firestop materials.

.7 To be installed in fire rated walls where cable tray must penetrate fire rated walls.

.8 All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate fire-stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure).

.9 Provide fire stop system where cable /cable tray penetrates fire rated walls, floors, partitions and ceilings to ensure that the fire rating is maintained. For conduit penetration, Putty or other type firestop shall be used. Abandoned penetrations shall be properly fire stopped.

.10 The required fire rating is minimum 2 hours.

.11 Firestop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by a qualified Professional Engineer, licensed (actual or reciprocal) in the province where the work is to be performed. A drawing showing the proposed fire-stop system, stamped/embossed by the Contractor's Professional Engineer, shall be provided to the Contract Administration prior to installing the fire-stop system(s).

.12 Firestop system size based on cable quantities plus future additional 20% cable expansion needs.

3 Execution

3.1 GENERAL

.1 Pathways shall meet the requirements of current ANSI/TIA-569.

.2 Pathways should be compatible with the worst-case environment to which they will be exposed (see current ANSI/TIA-568 for information on environmental classifications).

.3 Pathways shall comply with local codes and regulations.

.4 Cable tray shall be used above ceilings in commercial facilities.

.5 All pathway (conduit and cable tray) systems shall be installed in accordance with the latest version of the ANSI/TIA 569 Standard which exceeds the minimum requirements of Canadian Electrical Code. Pathway systems that are designed only to the Canadian Electrical Code and do not include all requirements of the current ANSI/TIA 569 standard will be considered substandard and removed until such time as they are in compliance.

.6 Contractor to confirm with Contract Administrator regarding the areas that are suitable for conduit.

.7 Contractor to confirm with Contract Administrator regarding the areas that are suitable for cable tray, if suitable, what material type given the impact of certain airborne chemicals (aka Chlorine) that corrode metals.

.8 Cable tray and conduit shall be labeled every 15 meters (50 ft.) on the outer surface as "LAN BACKBONE" or "LAN HORIZONTAL".

.9 There shall be small labels identifying the source and destination of cables in case there are multiple cables carried by the cable tray and conduit.

3.2 INSTALLATION AND INSPECTION - GENERAL

.1 The equipment/products shall be installed as indicated on the Contract Drawings and these specifications, in accordance with the Manufacturer's recommendations and as approved by the Contract Administrator.

.2 Provide the services of a factory trained representative(s) to inspect, operate, test, adjust, and troubleshoot the installations.

.3 Inspection to include checking for:

.1 Cracks and other damaged or defective parts. Each equipment/product, as well as accessories, must be undamaged, without cracks and free of defective parts.

.2 Completeness of installation as specified and as recommended by the Manufacturer.

.3 Correctness of setting, alignment and relative arrangement of various parts of the system.

.4 Provide for additional supervision of installation by Equipment Manufacturer as required. Arrange with the Contract Administrator a mutually agreeable date when the representative should be on site.

.5 Complete on-site testing (and off-site testing where specified), and provide the results of the tests.

.6 Submit a report, signed by the Manufacturer's representative, describing in detail the inspection, tests, and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verify that the equipment/products conform to all specifications.

3.3 SUPERVISION OF INSTALLATION AND COMMISSIONING - GENERAL

.1 Provide commissioning and startup in accordance with Section 01 91 00– Commissioning and these specifications.

.2 At the completion of satisfactory installation, each unit shall be started by the Contractor under the supervision of the Manufacturer and in conjunction with plant operating conditions.

.3 Equipment/products shall only be accepted after receipt of a satisfactory report submitted by the Manufacturer's representatives.

.4 Modify or replace equipment/products failing required tests.

.5 Perform additional testing required due to changes of equipment/products and/or failure of equipment/products or construction to meet specifications at no extra cost to the City.

3.4 PERFORMANCE TESTS - GENERAL

.1 Complete on-site testing (and off-site testing where specified) and provide the results of the tests.

.2 The field service representative(s) shall submit to the Contract Administrator a written report stating that the equipment/products have been checked and is suitable for operation.

3.5 J-HOOK INSTALLATION

.1 Provide J-Hook support along “free-air” cable pathway routes. Provide J-Hooks at maximum 1.5m intervals and at offsets. Route J-Hooks above ceilings through corridors and similar open areas wherever possible to minimize above-ceiling wall penetrations.

.2 Layout and install all electrical work in strict compliance with Chapter 1, Part B, Section 110.26 of the latest adopted edition of NFPA 70. Locations and routing that may be shown on plans are schematic and diagrammatic in nature. Layout all proposed pathway routing, elevations, installation methods, etc. on coordination drawings and coordinate all proposed routing with all affected trades prior to commencing with work. In addition, review the information with Contract Administrator for all areas where pathways will be visible after completion of construction, to ensure a neatly organized installation occurs. Where exposed in finished areas, install in a manner that minimizes detrimental effects on room aesthetics. Install as out of site as reasonably possible.

.3 Keep pathways at least 24 inches away from parallel runs of flues and steam or hot- water pipes. Install horizontal runs above liquid and steam piping. Level and square runs and install at proper elevations and heights. Do not begin installation of cables until J-Hook pathway installations are complete and until installation locations (end to end) are in a weatherproof environment. Install pathways so that they are accessible for cable installation after construction is complete. Install pathways with enough workspace to permit access for installing cables. Strictly adhere to factory load capacities and fill capacity. Provide factory cable retainers, fasteners, attachment kits, and other accessories as required for a complete installation.

.4 Securely anchor (mechanical, not adhesive) J-Hooks directly to structural components of the building. Do not anchor J-Hooks to ductwork, conduit, piping, fixtures, equipment, ceiling supports (rods, wires, t-bars), etc. Comply with requirements in Section 26 05 00and related sections for hangers and supports. Support using factory- approved methods. Fasten cables on horizontal runs with factory cable clamps, retainers, fasteners, attachment kits or flexible hook-and-loop fasteners-secured (i.e. Velcro or equivalent) wraps compliant with to NEMA VE 2. Tighten clamps/wraps only enough to secure the cable, without indenting the cable jacket. Use of synthetic or plastic “tie-wraps”, “zip ties”, “wire ties” and similar products are not permitted as a permanent means of anchoring, securing, supporting or otherwise installing any cables, conductors, conduits, raceways, devices, equipment or other electrical work. Do not use perforated strap.

.5 Coordinate work prior to rough-in with respective equipment and cable installers, and with the Contract Administrator. Carefully coordinate proposed routing, including elevations, with affected installers and entities prior to rough-in. Neatly route paths parallel and perpendicular to building architectural lines, plumb on walls, and at a consistent elevation wherever possible. Install paths in a uniform plane/elevation wherever possible. Keep horizontal and vertical offsets to an absolute minimum. Route paths so that a minimum of 24 inches exists between cables and potential EMI sources such as lighting ballasts, motors, power wiring, dimmer circuits, etc.

.6 Provide a minimum of two (2) 103mm (4-inch) bushed conduit sleeves where pathway is routed above inaccessible ceilings, and at penetrations of floors, masonry walls, fire rated walls, smoke-tight partitions, smoke-rated partitions, and similar elements. Provide smoke and fire stopping at such penetrations as applicable in (see Section 26 05 02). Provide EMT conduit for “drops” from paths to outlets and equipment, with sweep bends, insulated throat fittings and 200-pound pull string.

3.6 CABLE TRAY INSTALLATION

.1 All cable trays shall be wire-mesh/basket-tray type, pre-fabricated structure. Refer to drawings for cable tray sizes.

.2 Should aluminum trays be specified, the Contract Administrator is to ensure that, during the grounding or bonding aspects of the installation, the Contractor uses tin plated or zinc coated ground connectors.

.3 All metal cable trays shall be bonded together to the PBB or an SBB.

.4 All metal cable trays shall be coated to prevent rust or galvanic action. Only pre-galvanized cable trays shall be acceptable. Post galvanized hot dipped trays and components are not acceptable.

.5 Accessories and fittings such as elbows and reducers shall be manufactured by the cable tray manufacturer.

.6 Install cable trays at least 300mm away from fluorescent luminaries and cross power cables at right angles.

.7 The minimum clearances for cable trays shall be in accordance with Canadian Electrical Code C22.1-09

.8 Allow 150mm vertical clearance excluding the depth of cable trays, between cable trays installed in tiers except where cables of 50mm diameter or greater are installed then the clearance shall be 300mm, and Minimum 200mm vertical clearance from the top of cable trays to all ceilings, 300mm clearance from heating ducts and heating equipment and 150mm for short length obstructions.

.9 A minimum of 75mm clear vertical space shall be available above the ceiling tiles for the cabling and pathway.

.10 600mm horizontal clearance on one side of cable tray mounted adjacent to one another or to walls or other obstructions.

.11 All cable trays shall be labeled at regular intervals. The distance separating labels shall not exceed 15 meters.

.12 The maximum cable tray fill ratio is 50% (on field)

.13 Cable tray is to be used for all communication cables not run-in conduit/raceway. Provide partitioning to separate individual system cables.

.14 Waterfall tray shall be installed above Network/Server rooms to meet the bend radius requirements of cable installation.

3.7 CONDUIT INSTALLATION

.1 Conduit shall be installed as indicated in the drawings. Only Hook-and-loop fasteners ties (i.e. Velcro or equivalent) are allowed. Plastic cable ties are not allowed in any condition.

.2 The inside radius of a bend in a conduit shall be not less than six times the internal diameter when the conduit is less than 50mm (2”) in diameter and ten times the internal diameter when conduit is 50mm (2”) in diameter or larger.

.3 All zone conduits shall be identified and labeled at both ends, any transition section and at regular intervals not to exceed 10 meters. Tags shall identify start and finish of conduit runs. Pull boxes shall be labeled on the exposed exterior.

.4 All conduits shall originate and be physically connected to the telecom backboards in the Equipment Room, Telecommunications Room, cable tray and pull box.

.5 All metallic parts of the cable distribution supporting system shall be bonded together mechanically inclusive of all transition points (i.e., cable tray and distribution conduit not mechanically connected) using a 6 AWG green jacketed stranded copper ground wire. The metallic components of the cable distribution system shall be bonded together at the communications/server rooms, and then bonded to their respective telecom ground busbars.

.6 All fittings, connectors and couplings shall be of the same material as the conduit used on site.

.7 All conduits/sleeves that enter the communications/server rooms shall be fitted with an approved ground bushing with ground lug and bonded together mechanically (one continuous piece preferred). This shall be connected to the approved building ground by means of a No. 6 AWG to the grounding bus bar.

.8 Cable fill capacities of conduit shall not be greater than 40%, plus 25% spare for future installation.

.9 All conduits entering or existing through the ceiling or walls of the communications/server rooms shall protrude into the room 25-50mm.

.10 Riser sleeves in the communications/server rooms shall protrude through the floor 50-75mm above finished floor (AFF).

.11 All conduit runs shall follow building grid lines and shall be concealed where possible.

.12 All conduits shall be the types as per the application, reamed and bushed at both ends and bonded to the distribution system.

.13 All conduit runs shall not exceed a maximum of 30 meters (100 ft.) in length with a maximum of two 90-degree bends between pull points without a pull box, unless otherwise specified.

.14 Conduits ending in the vicinity of a cable tray shall be terminated at a height of no less than 100mm and no more than 150mm from the top of the cable tray. Conduit runs shall not be punched through the side of the cable tray. Conduit ends are to be bonded to the cable tray.

.15 The use of LB, LL, LR, C and T type fittings are not permitted. Only LBs designed and manufactured for communications systems are allowed where applicable.

.16 Conduit fittings shall not be used in place of pull boxes or bends.

3.8 PULL BOX INSTALLATION

.1 A pull box shall be placed in conduit runs where the sum of the bends exceeds 180 degrees, where the overall length of the conduit run is more than 30m, or if there is a reverse bend in the run.

.2 Pull boxes shall be constructed and sized in accordance with Canadian Electrical Code, TIA and BICSI standards of code gauge steel and shall have a rust resistant finish.

.3 In all instances pull boxes shall be placed in straight sections of conduit run and shall not be used in lieu of a bend. Corresponding ends of the conduit are to be aligned with each other. Conduit fittings shall not be used in place of pull boxes or bends.

.4 Pull boxes shall be installed at a reasonable height, in an exposed location and such that access for installation of cables is not prohibited. Pull boxes shall not be placed in a fixed false ceiling space, unless immediately above a suitably marked and hinged access panel. Provide indicator decals on ceiling T-bar rail or ceiling tiles showing location of pull box or splice box.

.5 Conduit must enter the outlet boxes from the top or bottom.

.6 All conduits shall be installed in accordance with Canadian Electrical Code, Part 1 Section 12, applicable building codes and current TIA/EIA 569.

.7 The minimum trade size for conduit running between the Equipment Room or a Telecommunications Room and the Telecommunications outlet at an outlet location is twenty-seven millimeters (27mm).

.8 The maximum horizontal cable run distance shall not exceed 90 meters.

.9 The cable length from the mechanical termination in the TR and ER to the Telecommunications outlet, where the horizontal distance exceeds 90 meters, provided additional rooms and/or cabinets as required.

.10 Future requirements for additional cables to each outlet shall be considered.

.11 A pull cord shall be installed in all conduits and the pull cord shall be left inside of conduit (for future expansion) after cables installed.

.12 Place pull boxes in readily accessible locations only.

.13 The use of LB, LL, LR, C and T type fittings are not permitted. Only LBs designed and manufactured for communications systems are allowed where applicable.

.14 There shall be no attachment of pull boxes or any type of panel/enclosure onto the surface of the Telecom Enclosure / Cabinet / Rack. It is strictly prohibited and shall not be allowed in any circumstances to have a box or enclosure attached/fixed on the surface of a Telecom Enclosure / Cabinet / Rack.

3.9 INDOOR CABLE DISTRIBUTION

.1 All pathways and cabling installation shall maintain clearances from all electrical and heat sources as outlined below.

Fluorescent Fixtures	30 cm
Electrical distribution cabling and conduits less than 1KVA	1.0 m
Electrical distribution cabling and conduits greater than 1KVA	3.0 m
Transformers and Motors	1.2 m
HVAC system including ducts	30 cm
Mechanical piping	15 cm

.2 Prepare all conduits and pathways prior to installation of cabling. This shall include bushing or reaming all conduit openings, pulling of wire brush and mandrel to clean out ducts and identifying any potential cause of damage to cabling during installation. Report all items to the Contract Administrator immediately.

3.10 OUTLET BOXES, CONDUIT BOXES AND FITTINGS

.1 Support boxes Independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armored cable connections. Do not install reducing washers.

.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes as required.

.7 For all public areas, elevator lobbies, corridor, and stair/landing areas. All conduits and/or cable trays are crossing those areas are to be rigid conduits and enclosed trays with secured covers. Also, for more conduit details, refer to Section 16134.

3.11 CLEANING

.1 Proceed in accordance with Section 01 74 00 – Cleaning.

.2 On completion and verification or performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

3.12 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for communication raceway systems installation in accordance with manufacturer's written instructions.

3.13 INSTALLATION

.1 Install empty raceway system, including ceiling distribution system, fish wire, cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, concrete encased ducts, miscellaneous and positioning material to constitute complete system.

3.14 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by pathways for communications systems installation.

3.15 STORAGE

.1 Prior to installation, the equipment/products and accessories shall be protected and stored indoors in a dry area, in accordance with the Manufacturer's recommendations.

3.16 OPERATION AND MAINTENANCE (O&M) DATA

.1 Submit Operation and Maintenance (O&M) Data for all equipment/products in this Section in accordance with Section 01 78 00 – Closeout Submittals.

3.17 TRAINING

.1 Unless otherwise specified, provide Demonstration and Training in accordance with Section 01 79 00 – Demonstration and Training.

END OF SECTION

1 GENERAL

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 01 33 00 – Submittal Procedures.

.3 Section 01 45 00 – Quality Control.

.4 Section 01 61 00 - General Product Requirements.

.5 Section 01 74 00 – Cleaning and Waste Processing.

.6 Section 01 78 00 – Closeout Submittals.

.7 Section 01 79 00 – Demonstration and Training.

.8 Section 01 91 00 – Commissioning.

.9 Division 26

.10 27 05 00 – Common Work Results for Communications

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 214-02, Communications Cables (Bi-National standard with UL 444).

.2 CSA-C22.2 No. 232, Optical Fibre Cables.

.2 TIA/EIA, Latest version:

.1 TIA/EIA-568 D Series Commercial Building Telecommunications Cabling Standard.

.2 TIA/EIA-569 Commercial Building Standard for Telecommunications Pathway and Spaces.

.3 TIA/EIA-606 Administration Standard for Commercial Telecommunications Infrastructure.

.4 TIA/EIA-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

.5 TIA/EIA-758 Customer Owned Outside Plant Telecommunications Cabling Standard.

.6 TIA/TSB-184 Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling

.3 BICSI, Latest version:

.1 BICSI - Outside Plant Design Reference Manual.

.2 BICSI – Telecommunication Distribution Methods Manual.

.3 BICSI – Information Transport System Installation.

.4 BICSI – Network Design Reference Manual.

.5 ANSI/BICSI 005 Electronic Safety and Security (ESS) System Design and Implementation Best Practices

.4 Local Codes and Standards – all applicable

.5 Local Authority Having Jurisdiction (AHJ)

.6 Institute of Electrical and Electronics Engineers (IEEE)

1.3 DEFINITIONS

.1 Refer to TIA/EIA-598, Annex A for definitions of terms: optical-fibre interconnect, distribution, and breakout cables.

1.4 SYSTEM DESCRIPTION

.1 Structured telecommunications wiring system consist of unshielded-twisted-pair and optical fibre cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications and security systems, including voice, data, CCTV and access control.

.2 Installed in physical star configuration with separate horizontal and backbone sub-systems.

.1 Horizontal cables link work areas (CCTV locations, CAT6A drops, etc.) to telecommunications cabinet/space.

.2 Telecommunications spaces linked to main terminal/equipment room (MT/ER) in main operations building by backbone cables.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 The submission shall include, but not be limited to, the following:

.1 Confirmation of the understanding of the milestones, timelines and sequence of construction within Section 01 11 00.

.2 Other submittals as listed in this specification and for all equipment/products.

.3 Provide Microsoft Access database reflecting cable installation and cross-connections.

.4 Provide electronic drawings in AutoCAD format depicting all construction.

.5 Provide electronic copies of record drawings to City Representative.

.6 Provide and place one hard copy of record drawings for each telecommunications space.

1.6 SUBMITTALS

.1 Shop Drawings: Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit Commissioning forms in accordance with Section 01 91 00 – Commissioning with Manufacturer’s/Contractor’s forms appended.

.3 Submit Operation and Maintenance (O&M) Data for all equipment in this Section in accordance with Section 01 78 00 – Closeout Submittals.

1.7 QUALITY ASSURANCE AND CONTROL

.1 Refer to Section 01 45 00 – Quality Control.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 15 – Health and Safety.

1.8 PRE-QUALIFICATION CERTIFICATE:

.1 Contractor shall submit the following documents with project proposal:

.1 Submit proof from manufacturer of the Contractor’s good standing in the cabling manufacturer’s qualification program.

.2 Submit training certificates for design, engineering and installation of the proposed products awarded to the Contractor’s assigned project manager and installer. All installers working on this project shall be certified in the manufacturer’s certified installers program.

1.9 WARRANTY DOCUMENTATION

.1 Complete documentation regarding the manufacturer's Extended product Warranty and Application Assurance Program shall be submitted a part of the proposal. This shall include, but is not limited to: a sample of the warranty that will be provided to the customer when the installation is complete and documentation of the support procedure for warranty issues and guaranteed performance information.

.2 A system application assurance manual documenting the vendor supported applications and application guidelines shall be provided as part of the submittals.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing.

2 PRODUCTS

2.1 CATEGORY 6A CABLING MANUFACTURER

.1 Category 6A cabling products shall be selected from single manufacturer, and include, but not limited to cables, patch cords, patch panels, and associated accessories/components.

.2 Approved Cabling manufacturer:

.1 Wirewerks

.2 Belden

.3 CommScope

.4 Hubbell

.5 Panduit

.6 Or approved equal

2.2 CATEGORY 6A TWISTED PAIR CABLE

.1 Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6A cable at frequencies up to 500MHz.

.2 Standard: Comply with TIA-568.2 for Category 6A cables.

.3 Conductor: 100-ohm, 23 AWG solid copper.

.4 Shielding/Screening: Unshielded balanced twisted pairs (UTP)

.5 Indoor Category 6A Cable Rating: Plenum rated unless fully enclosed in conduit.

.6 Outdoor Category 6A Cable Rating: Outdoor rated if outdoor for any distance.

.7 Horizontal cable, patch cords and RJ-45 module jacks colour-coded:

.1 Blue for data outlets.

.2 White for voice outlets.

.3 Yellow for security outlets.

.4 Any other system cabling to be confirmed and differentiated as required.

.8 Operating Temperature: -40°C to +75°C

2.3 UTP 4-PAIR TERMINATION JACKS

.1 All UTP telecommunications jacks shall be Category 6A T568A, 8P8C, single telecommunications jack with flush exit.

.2 4-port decora style inserts shall be utilized for the connection and termination of jacks at outlet end, unless otherwise noted. White colour shall be used at wall locations and colour(s) matching electrical floor boxes and furniture adaptors shall be utilized at floor and furniture locations, respectively.

.3 Filler plates to be installed at all unused termination slots. Filler plate colour to match inserts.

.4 Install faceplate for communications outlets where outlets are not ganged with electrical outlets. Colour to match electrical faceplates within the vicinity. Where no electrical back box has been installed, install a low voltage ring to be used for faceplate mounting.

.5 Install category 6A jacks at each outlet location and at termination patch panel.

.6 Category 6A jacks colour: Refer to item 2.2.7 this Section.

.7 In addition, Category 6A Copper Jacks must meet the following mechanical and performance criteria:

.8 Exceed ANSI/TIA-568.2 Category 6A and ISO 11801 2nd Edition Class E standards

.9 Meets requirements of IEEE 802.3af, IEEE 802.3at and IEEE 802.3bt for PoE

.10 Be 100% tested to ensure NEXT and RL performance and be individually serialized for traceability.

.11 Colour-coded, keyed jack modules mechanically and visually distinguish connections to prevent unintentional mating with unlike keyed or non-keyed modular plugs accommodating more discrete networks.

.12 Have contacts plated with 50 micro inches of gold for superior performance.

.13 3rd party certified to meet the mechanical endurance to the standard requirement of IEC 60512-99-001 for support of remote power applications with test current of 2 Amperes per conductor (for future PoE++ applications). Require no punch down tool.

.14 Have range to terminate 4-pair, 22 – 26 AWG, 100 ohm, solid or stranded twisted pair cable.

.15 Jack wiring scheme: T568A.

.16 Accept 6 and 8-position modular plugs without damage to conductor pins.

.17 Identified options that include optional labels and icons.

.18 Be compatible with Modular Patch Panels, Faceplates, and Surface Mount Boxes.

.19 For locations with tight bend radius concerns, have optional termination caps available that allows the cable to be routed either left or right, or up or down, and not directly interfere with neighboring jacks.

.20 The unshielded jacks shall be serialized such that it is visible on the connector when removed from the packaging.

.21 Safety: UL 1863 listed, use as communications circuit accessory. Also investigated to UL2043, for use in air-handling spaces (plenum).

2.4 UTP PATCH CORDS

.1 Factory-installed male plug at other end to mate with "RJ-45" jack to: TIA/EIA-568.2 "RJ-45" jack Category 6A, 4 pairs, for cross-connect between the patch panel and the network switch. For patch cord colours refer to item 2.2.7 of this section.

.2 Patch cords at the termination closet end to be 1m (4’), 2m (7’) and 3m (10’) cables, as required to reach switches from termination patch panels.

.3 All patch cords at the workstation/office end to be 3m (10'), unless otherwise noted.

.4 Provide a patch cord for each end of horizontal cables shown on drawings, plus 10% spare.

.5 For wireless access point (WAP) and CCTV camera outlet locations, it is alternatively acceptable to terminate horizontal cabling with a Category 6A approved field terminatable plug hardware (i.e. Belden RevConnect plug or approved equivalent product) to allow for direct connection to the device without a patch cable. Field terminated plugs shall not be utilized.

2.5 UTP PATCH PANEL

.1 Modular (RJ45) patch panels.

.2 Designed for high-speed data, cross connect and interconnect specifications.

.3 All UTP, 4 pair, CAT6A horizontal cables shall be terminated on 19" rack mountable patch panels; 24 port 1U and/or 48 port 2U per panel suitable for modular jacks. Patch panels shall be black in colour.

.4 Provide each port with a T568A (ISDN) eight pin jack as necessary to accommodate number of runs.

.5 Provide patch panels in each data rack, quantity of panels as required to connect each data outlet to a corresponding patch panel port plus a minimum of 10% spare ports (based on quantity of terminated cables).

.6 1U and 2U high, horizontal minders must be mounted for cable management of patch cables as shown on drawings. Horizontal minders shall be black in colour.

2.6 25-PAIR CATEGORY 5E CABLE

.1 Description: 25-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5E cable at frequencies up to 100MHz.

.2 Standard: Comply with TIA-568.2 for Category 5E cables.

.3 Conductor: 100-ohm, 24 AWG solid copper.

.4 Shielding/Screening: Unshielded balanced twisted pairs (UTP)

.5 Cable Rating: Plenum rated if installed within plenum space without conduit. Non-plenum rated acceptable if fully enclosed in conduit or within non-plenum space.

2.7 OPTICAL FIBRE CABLING MANUFACTURER

.1 Optical fibre cabling products shall be selected from single manufacturer, and include, but not limited to cables, patch cords, patch panels, and associated accessories/components.

.2 Approved Cabling manufacturer:

.1 Corning

.2 Belden

.3 CommScope

.4 Hubbell

.5 Wirewerks

.6 Or approved equal.

2.8 9/125 MICROMETER, SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBRE CABLE

.1 All fibre to be enclosed in conduit between termination rooms for protection.

.2 All indoor fibre cabling shall be OS1/indoor rated. All cabling outdoors for any distance shall be OS2/outdoor rated.

.3 Strand counts as indicated on drawings. Note variety of quantities required i.e. 4-strand, 6-strand, 12-strand, 24-strand and 48-strand.

.4 Standards:

.1 Comply with TIA-492CAAB for detailed specifications.

.2 Comply with TIA-568-3 for performance specifications.

.3 Comply with ICEA S-104-696 for mechanical properties.

.5 Maximum Attenuation: 0.5dB/km at 1310 nm; 0.5dB/km at 1550nm.

.6 Cable Rating: Indoor rated for indoors, outdoors rated for outdoors, indoor/outdoor rated for any cables running both indoors and outdoors.

.7 Cable cordage jacket, fibre, unit, and group colour shall be according to TIA-598. Imprinted with fibre count, fibre type, and aggregate length at regular intervals not to exceed 1000 mm.

2.9 OPTICAL-FIBRE CONNECTORS

.1 Include for all required termination components.

.2 All fibres shall be terminated with duplex LC type connectors with ceramic ferrule adapters to: TIA/EIA-568.1.

.3 Duplex LC connectors shall be utilized.

.4 Maximum insertion loss per mated connector pair shall be 0.5dB.

2.10 OPTICAL-FIBRE PATCH PANEL

.1 Mounted in cabinet, size as indicated on drawings.

.2 All fibre connector panels shall be installed with duplex LC fibre adapters with ceramic sleeve and fibre designation strip. For multimode fibres, the quantity of adapters per panel shall be determined by the number of fibres being terminated.

.3 When the above noted rack mounted patch panel does not fit the enclosure, where wall mounted cabinets/racks are utilized, single-panel housing may be utilized complete with 12-port LC duplex adaptors.

.4 Fibre patch panels to accommodate splice trays without modification to panels.

2.11 OPTICAL FIBRE CONNECTOR HOUSING

.1 Single-drawer housing with space for horizontally mounted connector panels. Housing shall have slide-out drawer with label sheet, smoked shatterproof polycarbonate door with latch, and deep front shelf area to provide adequate strain relief for cables.

2.12 OPTICAL-FIBRE PATCH CORDS

.1 Single-mode fibre patch cords shall match the wavelength of the used backbone cable.

.2 Patch cords lengths shall be 2m, 3m and 5m as required to reach equipment as shown on drawings.

.3 Patch cords shall be complete with duplex LC connectors at both ends.

2.13 CABINETS, RACKS, ENCLOSURES AND ACCESSORIES

.1 Approved manufactures:

.1 APC

.2 Belden

.3 CPI Chatsworth

.4 Eaton/Tripp Lite

.5 Middle Atlantic

.6 Panduit

.7 Approved equal

.2 Provide and install as shown on drawings.

.3 All cabinets and accessories (such as cable managers, PDUs, etc.) shall be black in colour.

.4 Shall have grounding provisions.

.5 Shall be designed to accept EIA/TIA standard 483 mm (19") wide panels drilled and tapped to accept size 12-24 or 10-32 screws, in increments of 44.5mm (1.75"), with permanently marked U-spacing identification

.6 Shall be metal fabricated, a minimum of 2.5mm thick with equipment mounting rails a minimum of 2mm thick.

.7 Free Standing Cabinets:

.1 Sized 750mm (30") wide by 900mm (36") deep

.2 Shall have a minimum of 42U of useable space.

.3 The cabinet roof panel to have grommet type holes for cable installation.

.4 Two sets of mounting rails (front and back).

.5 Perforated front door.

.6 Split perforated rear doors.

.7 Solid panels.

.8 Casters and leveling feet.

.9 Door handles and locks.

.10 Supplied with minimum of two (2) black steel shelves.

.11 Equipped with one (1) rack mounted grounding busbar each.

.12 Equipped with two (2) vertical Power Distributed Units (PDU) each:

.1 Input Plug: L5-20P.

.2 Input Cord: 3m (10ft).

.3 Output Receptacles: Minimum of (8) NEMA 5-20R T-slot.

.4 Shall not have any power on/off switches.

.5 Shall be vertically mounted at cabinet rear.

.13 Equipped with two (2) vertical wire managers each:

.1 Shall be a minimum of 100mm (4") wide by 100mm (4") deep.

.2 Consist of plastic finger style patch cable management extending the full height of the cabinet.

.3 Channel style supports heavy cable load, while maintaining clean concealed appearance.

.8 Vertical Wall Mounted Cabinets:

.1 Shall be approximately 600mm – 660mm (24"-26") wide by a minimum 660mm (26") high.

.2 Shall have 6U available (vertical) mounting positions (with an overall depth less than 350mm).

.3 Shall be lockable.

.4 Shall be minimum NEMA 3 rated (for garage/storage areas).

.5 Cabinets shall allow for front access or allow for tilting if access is from the top.

.6 Cabinets shall be complete with dust filters.

2.14 CABLE BUNDLING MATERIALS

.1 Provide hook and loop tape, that is at least 12mm wide, of a length equal to 150% of the circumference of the cable bundle.

.2 Plastic tie wraps are not allowed.

.3 When used in areas considered environmental air spaces, all bundling materials must be appropriately listed.

2.15 IDENTIFICATION AND LABELLING

.1 Develop and employ a uniform wiring identification system that is consistent with AS-BUILT documentation, existing standards, and manuals.

.2 All labels shall meet requirements for legibility, defacement, and adhesion specified in UL969. ‘

.3 Labels shall be provided for all cables, faceplates and termination panels/components. Each cable run shall have a minimum of four (4) labels, at each cable end as a wrapped cable label, as well as on the associated termination faceplate and termination patch panel.

.4 Cable labels shall be self-laminating vinyl with white printing area, minimum 10pt font size and clear overlaps. The length shall be sufficient in size to allow overlap to be completely wrapped around two (2) times.

.5 Label each of cables with other end’s address using wire identification materials.

.6 Faceplate and patch panel labels shall be adhesive vinyl with white printing area, minimum 10pt font size.

.7 Label outlets with labels vertically aligned in each row.

.8 Label all cabling passing through junction- and pull-boxes indicating cabling function and termination details consistent with the identification system.

.9 Conduits shall also be labelled at both ends indicating services used within the conduit.

.10 All racks and cabinets shall be labelled with 2” high lamacoid engraved plates indicating cabinet type and designation.

.11 Position panel labels in the same position on each panel.

2.16 WI-FI SYSTEM

.1 Contractor to provide CAT6A cabling, backbox, pull boxes, j-hook/conduits and pathways as per design documents.

.2 Refer to drawings for preliminary layout for pricing purposes of cabling to be supplied and installed.

.3 Contractor shall be responsible to hire 3rd party, as required, to validate wireless access point locations and determine final layout based on heatmaps generated with appropriate simulation-software.

.4 Wireless access point hardware to be supplied by the city and installed by the contractor. Contactor to include for testing and validation post installation.

3 EXECUTION

3.1 INSTALLATION AND INSPECTION - GENERAL

.1 The equipment/products shall be installed as indicated on the Contract Drawings and these specifications, in accordance with the Manufacturer's recommendations and as approved by the Contract Administrator.

.2 Provide the services of a factory trained representative(s) to inspect, operate, test, adjust, and troubleshoot the installations.

.3 Inspection to include checking for:

.1 Cracks and other damaged or defective parts. Each equipment/products, as well as accessories, must be undamaged, without cracks and free of defective parts.

.2 Completeness of installation as specified and as recommended by the Manufacturer.

.3 Correctness of setting, alignment and relative arrangement of various parts of the system.

.4 Provide for additional supervision of installation by Equipment Manufacturer as required. Arrange with the Contract Administrator a mutually agreeable date when the representative should be on site.

.5 Complete on-site testing (and off-site testing where specified), and provide the results of the tests.

.6 Submit a report, signed by the Manufacturer's representative, describing in detail the inspection, tests, and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verify that the equipment/products conforms to all specifications.

3.2 SUPERVISION OF INSTALLATION AND COMMISSIONING - GENERAL

.1 Provide commissioning and startup in accordance with Section 01 91 00 – Commissioning and these specifications.

.2 At the completion of satisfactory installation, each unit shall be started by the Contractor under the supervision of the Manufacturer and in conjunction with plant operating conditions.

.3 Equipment/products shall only be accepted after receipt of a satisfactory report submitted by the Manufacturer's representatives.

.4 Modify or replace equipment/products failing required tests.

.5 Perform additional testing required due to changes of equipment/products and/or failure of equipment/products or construction to meet specifications at no extra cost to the City.

3.3 PERFORMANCE TESTS - GENERAL

.1 Complete on-site testing (and off-site testing where specified) and provide the results of the tests, all in accordance with the timelines and requirements listed in Section 01 11 00 – Summary of Work and these specifications.

.2 The field service representative(s) shall submit to the Contract Administrator a written report stating that the equipment/products have been checked and is suitable for operation.

3.4 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

.1 Install termination and cross-connect hardware on wall, in cabinet as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606.

3.5 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

.1 Install horizontal cables in conduits or cable trays from telecommunication spaces to individual work-area jacks. Identify and label as indicated to: TIA/EIA-606.

.2 Terminate horizontal cables in telecommunications room and at individual work-area jacks.

.1 Identify and label as indicated to: TIA/EIA-606.

.3 Coil spare cables and store in ceiling space in zone.

.4 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.

.5 Communications Contractor to refer to security and other discipline drawings for any copper and fibre cabling requirements, patch panels, terminations and other passive equipment, and shall supply and install these components.

3.6 INSTALLATION OF EQUIPMENT CABLES

.1 Install equipment cables from equipment patch panel as indicated.

.1 Identify and label as indicated to: TIA/EIA-606.

3.7 INSTALLATION OF WALL MOUNTED CABINET/ENCLOSURE

.1 Install wall-mount equipment cabinets/enclosure in accordance with manufacturer's instructions and City IT requirements at locations indicated on the Drawings.

3.8 IMPLEMENT CROSS-CONNECTIONS

.1 Implement cross-connections using patch cords as specified.

3.9 INSTALLATION OF IDENTIFICATION LABELS

.1 All identification labels shall be mechanically printed. Hand-written labels shall not be accepted.

.2 All labels installed on outdoor components must be rated for outdoor use.

.3 Cable labels shall be installed within 100mm (4") of each end prior to outlet installation/termination with clear overlapped, wrapped around a minimum 2 times. Separate cable labels shall be used to identify cables during cable pulls prior to termination to ensure final labels are clean and undamaged.

.4 Faceplate and patch panel terminations labels shall be installed in a neat and horizontally aligned manner. Ensure labels are placed on a clean and dry surface.

.5 All labels installed in outdoor cabinets, on outdoor components, or on cabling routed through outdoor conduits must be rated for outdoor use.

.6 Refer to drawings for cable labelling formats, which include prefixes and characters to indicate required termination room and floor.

3.10 TESTING/WARRANTY

.1 Copper Cable testing

.1 Testing of all copper wiring shall be performed prior to system acceptance.

.2 One hundred percent of the permanent installed links shall be tested for conformance to the manufacturers guaranteed performance levels as specified in the manufacturer's Extended Product Warranty platform.

.1 Any pairs not meeting or exceeding the requirements of the guaranteed performance levels shall be brought into compliance by the contractor, at no charge to the City.

.2 All cabling shall exceed the specifications of ANSI/TIA-568.2 (specific to the Category standards the cabling is manufactured to) by the margins (headroom) specified in the manufacturer's Extended Product Warranty platform.

.3 One hundred percent of the backbone cabling pairs shall be tested for opens, shorts, polarity reversals, transposition, and presence of AC voltage.

.4 All test equipment shall be updated with the latest firmware and software releases available from the manufacturer of the test equipment.

.5 All test equipment shall include valid proof of calibration within 6 months of the testing date. The calibration shall utilize the manufacturer's recommended calibration practices.

.6 Backbone/riser cables rated above Category 5e shall be tested according to test set manufacturer's instructions utilizing the latest firmware and software.

.1 Testing shall include all the electrical parameters.

.2 The detailed test results shall include the following:

.1 Wire Map

.2 Length

.3 Insertion loss

.4 Near-End Cross Talk (NEXT)

.5 Power Sum Near-End Crosstalk (PSNEXT)

.6 Equal-Level Far End Crosstalk (ELFEXT)

.7 Power Sum Equal-Level Far-End Crosstalk (PSELFEXT)

.8 Return Loss

.9 Propagation delay

.10 Delay skew

.7 Complete, end to end, test results must be submitted to City's Representative for review.

.2 Optical Fibre Cable Testing

.1 All fibre testing shall be performed on all fibres in the completed end to end system.

.2 Testing shall consist of a bidirectional end to end OTDR trace performed per EIA/TIA 455-61 or a bidirectional end to end power meter test performed per EIA/TIA 455-53A. Optical Certification testers may be used if approved in advance by the City's Representative.

.3 The system loss measurements shall be provided at (850 and 1310 nanometers for multimode fibres) and (1310 and 1550 for single mode fibres).

.4 Pre-installation cable testing

.1 The Contractor shall test all fibre cable prior to the installation of the cable and provide City's Representative with those test results prior to installation.

.2 The Contractor shall assume all liability for the replacement of the cable should it be found defective.

.5 Loss Budget

.1 Fibre links shall have a maximum loss of: Allowable cable loss per km)(km of fibre in link) + (.4dB)(number of connectors) = maximum allowable loss

.2 Maximum 0.3 dB for splice, 0.5 dB for mating connectors if required.

.3 A mated connector to connector interface is defined as a single connector.

.4 Any link not meeting the requirements of the standard shall be brought into compliance by the Contractor, at no charge to City.

.5 Documentation shall be provided in electronic form to the Contract Administrator.

.6 Complete, end to end, test results must be submitted to City's Representative for review (provide both PDF format and native tester file format).

.3 Extended Product Warranty Work

.1 Under the Extended Product the manufacturer shall replace any and all defective product or product not functioning to the levels guaranteed at the time of the warranty issue at the manufacturer's cost.

.2 The manufacturer shall engage an authorized manufacturer's reseller to repair or replace any such defective product on behalf of the manufacturer at no cost to the City.

.4 The Extended Product Warranty shall include a minimum one (1) year installation warranty for the premises copper and optical cabling to correct all installation related problems/ issues at no cost to the City.

.5 Replace cable and/or connection equipment that fails tests.

.6 Provide additional testing in accordance with Section 01 91 00 – Commissioning.

.7 Provide record of results as electronic record to: TIA/TSB-140.

3.11 STORAGE

.1 Prior to installation, the equipment/products and accessories shall be protected and stored indoors in a dry area, in accordance with the Manufacturer's recommendations.

3.12 OPERATION AND MAINTENANCE (O&M) DATA

.1 Submit Operation and Maintenance (O&M) Data for all equipment/products in this Section in accordance with Section 01 78 00 – Closeout Submittals.

3.13 TRAINING

.1 Unless otherwise specified, provide Demonstration and Training in accordance with Section 01 79 00 – Demonstration and Training.

END OF SECTION

1 General

1.1 SUBMITTALS

.1 Submit shop drawings for products and accessories specified in this Section. Include:

.1 system connection wiring schematic drawings;

.2 system design drawings including dimensions and layouts;

.3 sample graphic displays and nomenclature;

.4 system riser drawings including identification of connected auxiliary building systems and equipment;

.5 system proposed sequence of operations;

.6 annunciator schedules;

.7 copies of manufacturer's component literature sheets.

.2 Submit copies of final system testing and verification reports and certificates of approvals from local governing inspection authority.

.3 System Software

.1 Submit final version of custom system software in format confirmed with CM.

.2 Include copy in system O & M manuals.

1.2 SOFTWARE NOMENCLATURE REPROGRAMMING

.1 Include additional costs for system manufacturer to make necessary on-site final changes to applicable system/equipment software. Make such changes after successful testing and verification of systems, but prior to turn over to The City. After successful final verification of work, confirm and obtain approval of final nomenclature in writing from The City and review with Contract Administrator. Software revisions to incorporate final room names/area names/building names and equipment identification.

2 Products

2.1 FIRE ALARM SYSTEM GENERAL FEATURES

.1 Edwards "EST3" Series, multiplexed, single-stage, addressable, zoned, non-coded, indicating, fully integrated and field programmable system complete with emergency voice communications (EVC) and fire-fighters' communications. Entire system is designed as a centralized data communication and processing system.

.2 System components to be listed as products of a single manufacturer under appropriate category, by Underwriter's Laboratories of Canada and bear ULC label. System components and work in conjunction with system installation to meet specific application requirements of local governing authorities, codes, standards, regulations and requirements of following:

.1 CAN/ULC-S524, Standard for Installation of Fire Alarm Systems;

.2 CAN/ULC-S527, Control Units for Fire Alarm Systems;

.3 CAN/ULC-S537, Standard for Verification of Fire Alarm Systems;

.4 CAN/ULC-S1001, Integrated Systems Testing of Fire Protection and Life Safety Systems;

.5 local governing building code;

.6 local governing electrical code;

.7 local governing building permit applications for approvals;

.8 other requirements of local governing authorities.

.3 Devices to be ULC listed and labelled devices suitable for fire alarm applications. Power supplies and other components to be CSA approved where required by local governing authorities and codes.

.4 System to include but not be limited to following components:

.1 central processing units (CPU);

.2 EVC and paging system components;

.3 2-way supervised fire fighters' communication system;

.4 transponders/data gathering panels (DGP);

.5 initiating devices (manual stations, heat/smoke/flame detectors);

.6 alarm indicating devices (speakers, horns, strobes);

.7 smoke control and smoke venting;

.8 interfaces and interconnections to auxiliary building systems;

.9 wiring in conduit and/or fire rated cables.

.5 Exact type of device to be used in each area of installation to be as recommended by system manufacturer to suit specific applications and to be approved for such use as per ULC standards. Devices in non-climatic controlled areas to be weatherproof, corrosion resistant and ULC listed for use in below freezing temperatures. System manufacturer to be responsible for ensuring compliance with these requirements.

.6 With specific reference to audible and visual devices, determine exact type of devices and output settings to be provided to comply with ULC S524 and local building inspector requirements. Confirm, determine and set output levels of devices to meet local building inspector and ULC S524 dBA audibility and candela visibility levels for each location of devices as noted on drawings. Size power supplies accordingly and with spare capacity and maximum device loading as specified.

.7 System software to be of open protocol and be fully custom programmed with sequence of operations to suit specific project requirements. System programming to be performed by manufacturer's authorised technician. Include for system programming changes required for duration of project and as required for final acceptance and certification of entire system and project work, by local governing fire and buildings authorities. Include for additional 2 onsite programming periods after successful system testing and verification of system, for any final revisions required by The City. Refer to Part 3 of this Section for additional programming requirements.

.8 Main panels, transponders and/or data gathering panels as defined in this Specification are intelligent, microprocessor based control panels that connect to and handle network communications in a peer-to-peer manner. Decisions pertinent to network are distributed among transponders such that there is no need for a central fire alarm control panel. Each transponder to have full system operations data available on display on LCD.

.9 If a group of transponders become isolated from rest of network ring, that group forms a sub-network with common interaction of monitoring and control remaining intact. Network is notified with exact details of lost communications. In event that a single transponder becomes unable to handle network token, network interface card continues communications to rest of network. Off-line transponder is reported as such to network and is periodically interrogated to determine if it is ready to be brought back on-line with rest of network.

.10 System data and points monitored and controlled by each individual transponder are capable of being made available to network and are available to be displayed at each transponder. Such points include:

.1 initiating circuit devices such as addressable analogue detectors, including detector type and detector values;

.2 conventional addressable or zone connected smoke, heat and flame detectors;

.3 addressable manual stations; sprinkler devices;

.4 control circuits such as speaker/strobe circuits, fan/elevator/smoke exhaust controls, electromagnetic lock controls or other similar operations.

.11 Network operations are via communication links that connect network transponders and include data transfer, an audio signalling bus serving remote amplifiers, and a two-way phone communications bus serving individually controlled fire phone circuits. Communications trunk wiring to be electrically supervised.

.12 Risers between network transponders to include minimally a No. 18 AWG twisted shielded cable for each riser, wired in Class A (as required by local fire authorities) identifiable loops in addition to other fire rated conductors. Final wiring requirements to be determined by system manufacturer to suit specific applications and local governing authority code requirements.

.13 Cabinet enclosures for main panels and transponders to be minimum NEMA 1 with additional sprinkler-proof provisions including gasketing of openings/doors and ventilation louvers designed to protect live components from water spray of activated sprinklers. Surface mounted panels to include drip shield. Panels to be wall mounted, enamel finished, steel cabinets. Where flush mounted, include suitable trim. Panel enclosures where mounted in finished public areas to be typically flush wall mounted and coordinated with Architectural finishes. Review requirements with Contract Administrator, prior to roughing-in.

.14 System to provide custom sequence of operation as outlined in Part 3 of this Section.

.15 Refer to Section entitled - Fire Detection Air Sampling System to be integrated with fire alarm system to provide fire detection smoke sampling.

2.2 MAIN PANELS/TRANSPONDERS

.1 Microprocessor based panels with general features as previously described and with functionality, controls and indicators generally as follows:

.1 Evacuation annunciation and communication (EVAC) facilities for relocation of building occupants and fire fighter deployment during an emergency condition, and general paging components.

.2 Controls for air handling equipment, master electromagnetic locks, and other interconnected equipment.

.3 Controls and indicators for integrated system are provided in panels. Controls and LED indicators include but are not limited to following:

.1 Operators annunciator panel/LCD display unit;

.2 Emergency voice communication;

.3 Fire-fighters' telephone communication;

.4 Bypass switches;

.5 Sprinkler system annunciation;

.6 Electromagnetic lock control consisting of master reset switch and release switch;

.7 Elevator control switches;

.8 Smoke control and smoke venting.

.2 Operators display unit to be LED/LCD type annunciator panels interconnected with controls. Controls are mounted in cabinet with a door and clear glass viewing window, such that indications and operating instructions are clearly visible. Door to be complete with a lock and two keys. Operator's interface panel includes:

.1 multi-character (8 lines X 21 characters) alphanumeric back-lit LCD display;

.2 common alarm led and push-button acknowledge switch;

.3 common supervisory led and push-button acknowledge switch;

.4 common trouble led and push-button acknowledge switch;

.5 signal silence switch;

.6 system reset switch;

.7 power on indicator;

.8 minimum 5 password protected programmable function keys/LEDs.

.3 Operators display unit additional features:

.1 LCD annunciator to be capable of simultaneously displaying minimum 8 separate events without requirement for scrolling;

.2 LED display annunciator panels of zones plus spare 20% for future zones;

.3 capacity to annunciate minimum 2500 network points and/or point lists on LCD Display;

.4 separate alarm and trouble historical event logs maintaining minimum 600 chronological events each; historical logs are stored in CPU's memory and are protected by a lithium battery that is supervised for a low battery condition; each recorded event includes time and date of that event's occurrence; user to be able to generate a report of both logs upon request;

.5 programming and interface flexibility to be similar to individual network transponders;

.6 supports USB, RS-232-C and other communications interface I/O ports to interface video display panels/keyboards and printers to access network information, perform control as programmed and output data and reports.

.4 Control Switches and LEDs to be included for following functions:

.1 one switch for each speaker circuit zone to allow emergency voice communication selection;

.2 one green LED for each speaker circuit zone to indicate voice communication ready-to-talk;

.3 one amber LED for each speaker zone to indicate a trouble condition on either of speaker circuits on that zone;

.4 one switch to allow for manual evacuation;

.5 one switch to allow for all talk;

.6 system master handset microphone;

.7 one switch for each EMERGENCY TELEPHONE CIRCUIT to allow 2-way communication selection;

.8 one green LED for each emergency telephone circuit to flash on a call-in condition, and to remain on steady when zone is selected;

.9 one amber LED for each emergency telephone circuit to indicate a trouble condition on circuit;

.10 one EVAC switch for each floor;

.11 one EVAC switch for each building; (as applicable);

.12 complex wide EVAC switch;

.13 system reset switch;

.14 signal silence switch;

.15 fan bypass switches and LEDs;

.16 elevators bypass switches and LEDs;

.17 electromagnetic lock release/reset switches.

.5 Common control indicators include but not be limited to:

.1 trouble buzzer;

.2 trouble LED;

.3 trouble silencing switch;

.4 power ON indicator.

.6 Integrated system to include internal electrical supervision of normal and standby power conditions and network data communications. In event of any troubles, condition to be indicated on both main panel LCD Display and at other network transponders as programmed.

.7 Opening enclosure door provides access to operating controls. Electrical connections are front accessible through hinged door and removable dead front panel.

.8 Panel to include circuitry and devices to transmit an alarm signal to device(s) provided by others (The City's arranged monitoring company) to send alarm signal to Fire Department or to an outside private protection company, in accordance with CAN/ULC-S561. Exact requirements to be coordinated with monitoring company and and/or security company.

2.3 MANUAL CONTROL STATION FOR BUILDING SERVICES

.1 Provide manual operators for control and monitoring of various building services related to fire alarm system and smoke control and smoke venting system. Provide components as specified, detailed and as required to provide smoke control, smoke venting, stairwell pressurization, magnetic door lock release, and other interrelated functions as per detail, schedule and notes on drawings. Sequence of operation to be as noted. Interconnect related systems. Controls to be mounted on fire alarm panels as part of main fire alarm system and be fully integrated to system.

.2 Provide supervised control wiring in conduit for following:

.1 from fire alarm system to fan shut-down contacts as specified and/or as required;

.2 from fire alarm system to automatic temperature controls of air handling equipment contacts as specified and/or as required;

.3 from selector switches to relays as shown and/or as required;

.4 to BAS system contacts as shown and/or as required;

.5 to centralized door lock controls as required;

.6 to system equipment as scheduled;

.7 to auxiliary equipment as required.

.3 Controls connected to dry contacts for interconnections to initiate proper sequence of fan operations, damper operations and other associated devices to provide smoke control and smoke venting functions as required and as controlled by building automation system of Mechanical Divisions.

.4 Where controls are installed in dedicated panel, enclosure to be of standards and quality of materials for fire alarm panels.

.5 Include colour graphic displays of building outline and zones as per drawing detail. Submit sample display with shop drawing submission. Standard and quality of displays to be as per fire alarm system graphics. Size of graphic to be minimum 1200 mm x 1200 mm.

.6 Provide engraved lamicoid identification nameplates with mounting screws and suitable nomenclature to label each operator. Confirm exact nomenclature with CM and review with Contract Administrator.

.7 Control operators and integrated systems to be inspected, tested, and verified as part of fire alarm system testing and verification.

.8 Co-ordinate work with work provided by Mechanical Divisions. Fire alarm system vendor to along with Mechanical Divisions Contractor and BAS system vendor, to prepare detailed matrix of fan and damper control interconnections providing operations forming part of overall fire alarm sequence of operation. Review schedule and associated work. Advise CM of any recommended changes or additions that may be necessary to comply with local governing codes and standards.

2.4 REMOTE TRANSPONDERS

.1 Remote transponders or data gathering panels (DGPs) to be configured as required, with general requirements previously specified and also complete with following:

.1 multi-character alphanumeric back-lit LCD display complete with ability to annunciate full system networked points;

.2 common alarm LED and push-button acknowledge switch;

.3 common security LED and push-button acknowledge switch;

.4 common trouble LED and push-button acknowledge switch;

.5 signal silence switch;

.6 system reset switch;

.7 power on indicator;

.8 communications interface into network;

.9 multiple level password protected programmable function keys/LEDs;

.10 local alert and EVAC tone oscillators and amplifiers.

.2 Transponders to allow for loading or editing of special instructions and operating sequences as required. Software operations to be stored in non-volatile programmable memory within each transponder. Loss of primary and secondary power to not erase instructions stored in memory. On-site programming changes to be password protected.

.3 Signal/Speaker circuits to be independently supervised and fused such that fault on one circuit to not affect operation of any of other circuits. Signal circuits to be configured as follows:

.1 Class "A" analogue addressable loop wiring for alarm initiating devices;

.2 Class "B" for EVC speakers and fire-fighter's handsets;

.3 redundant NFPA style 7 backbone wiring;

.4 rated at 2-amps of continuous power;

.5 capable of powering polarized 24 VDC audible signalling appliances.

.4 Amplifiers and tone generators to supply required signals for voice paging, alert, and evacuation tones to speaker circuits. Amplifiers to be sized to accommodate speaker load (assume 1 watt tapping for determination of quantity of amplifiers) plus an additional 20 per cent spare capacity per speaker zone to accommodate future additions. Spare capacity to take form of additional amplifiers, as required. Amplifiers to be continuously supervised for proper operation.

.5 Modules to be secured behind hinged locked door. Hinged locked doors to give access to operating controls but not expose live connections.

2.5 ADDRESSABLE DEVICE NETWORK

.1 System provides communication with addressable initiating devices and these devices are annunciated on control panel/transponder main LCD display. Annunciation includes following conditions for each point:

.1 zone/device location;

.2 type of device;

.3 detector status (normal/alarm/trouble);

.4 device missing/failed.

.2 Minimum of 100 addressable devices may be multi-dropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable.

.3 Each addressable device to be uniquely identified by an address code entered on each device at time of installation. Use of jumpers to set address will not be acceptable due to potential of vibration and poor contact.

.4 100% digital loop controller within control panel/transponder to interface with intelligent microprocessor-based detectors and modules.

.5 Loop controller connected to detectors and modules using any wiring material or method complying with local governing electrical code, without need for special shielded or twisted wire.

.6 Loop controller to be capable of supporting Class A (Style 7) or Class B (Style 4) circuits without need for additional hardware modules. Multiple branch circuits can be T-Tapped from Data Communications Link (DCL).

.7 Loop controller to be capable of automatically addressing devices connected to it electronically, without need to set switches at any of individual device locations.

.8 Loop controller to determine electrical location of each connected detector and module. Location and type of each connected device to be mapped and stored in memory in loop controller. Map can be accessed and displayed.

.9 Mapping report of devices connected to loop controller for confirmation of "as-built" wiring can be obtained. Mapping report shows electrical relationship of connected devices, including T-Taps, device types, and address of each device on circuit. Loop controller to report any additional device addresses, which may have been added to circuit, and/or changes that, may have been made to wiring. A specific trouble to latch on system until changes are verified and accepted in program by authorized personnel.

2.6 POWER REQUIREMENTS

.1 Control panels, transponders and annunciators to receive power via a dedicated fused disconnect circuit. Incoming power to system to be supervised so that any power failure must be audibly and visually indicated at transponder and remote annunciator. A green "Power On" LED to be displayed continuously while incoming power is present.

.2 Power supplies to have following operating characteristics:

.1 rated for 5 amps continuous duty;

.2 24 VDC filtered and regulated;

.3 power limited with a range of 20.4 VDC to 32 VDC;

.4 automatic "Brownout" transfers to standby batteries when supply voltage falls to below set limit.

.3 System to be provided with sufficient standby capacity to operate entire system upon loss of normal power in a normal supervisory mode for a period of minimum 4 hours, and immediately following, full load power (defined as power required for full signalling activation of devices both visual and audible for full alarm conditions) for not less than 15 minutes. Confirm requirements with local fire authority and amend to suit local fire authority requirements but noting that such amendments to not lessen requirements herein specified. Test and demonstrate these requirements. Refer to Part 3 of this Section. System to automatically transfer to standby batteries upon power failure. Battery charging and recharging operations to be automatic.

.4 Standby power for system to be produced by maintenance free, sealed lead acid or gelled cell batteries. System batteries to be supervised so that a low battery condition or disconnection of batteries to be audibly and visually annunciated at control panel. Battery chargers to have following operating characteristics:

.1 ability to charge batteries to 70% of their capacity within 12 hours;

.2 compatible with either lead acid or NiCad batteries;

.3 circuits requiring system operating power to be individually fused.

.5 System to be provided with transient voltage surge protection device (SPD) to protect system electronics from surges and spikes on power lines. SPD units to be as recommended by fire alarm system manufacturer.

.6 System to be provided with transformers as required to power ancillary devices and hardware.

2.7 ADDRESSABLE MODULES

.1 Addressable modules to be used for monitoring of water flow, valve tamper, non-addressable initiating devices, and for control of fans or dampers that require shutdown or manual control in an alarm condition.

.2 Addressable modules to monitor any N/O contact device and be capable of powering 2-wire smoke detectors. Addressable modules to communicate zone's status (normal, alarm, trouble) to transponder. Addressable module zone address to be set at time of installation via a dip switch package.

.3 Addressable modules to be able to provide supervised or non-supervised control of any control function. Addressable modules to communicate zone's status (normal, trouble) to transponder. Addressable modules to provide a double pole double throw relay for switching loads of up to 120 VAC. Each common leg of relay to be equipped with a replaceable fuse sized as required.

2.8 MANUAL STATIONS

.1 Manual stations to be addressable, single action, non-coded, single-stage, semi-flush mounted type. Manual stations to be break-glass, key locked and have sealed N/O contacts. One contact is to activate when handle is pulled down, activating a first stage alarm. Stations to be complete with auxiliary contacts to connect to other building systems, such as to release doors. Review exact sequence of operation with Contract Administrator prior to programming. Set station's address at time of installation.

.2 Manual stations in areas designated as barrier free to be of type operated with no grip handle feature as approved by local governing authorities and as recommended by system manufacturer.

2.9 DETECTORS AND BASES

.1 Addressable smoke and heat detector heads as specified below to lock onto their bases. Same base to be compatible for both smoke and thermal detectors. Upon removal of head, a trouble signal to be transmitted to transponder. Detector's address to be set at time of installation.

.2 Where required provide an additional alarm relay (Form C, SPDT), normally open contact, for auxiliary functions.

.3 Each detector to contain a LED that flashes each time it is scanned by transponder. When transponder determines that a detector is in alarm or a trouble condition, transponder to command LED on that '"detector" to turn on steady indicating abnormal condition.

.4 Each detector to be scanned by transponder for its type identification to prevent inadvertent substitution of another detector type. Transponder to operate with installed device but to initiate a "Wrong Device" trouble condition until proper type is installed or programmed detector type is changed.

.5 Detector bases include wiring terminals that are accessible to "room side" after mounting to a standard 100 mm (4") octagon box.

.6 Various types of bases to be provided to suit each respective application, which is to be confirmed with system manufacturer. Types include:

.1 standard type equipped with wiring terminals, for mounting to a standard 100 mm (4") octagon box and complete with tamper-resistant mechanism to prevent unauthorized removal of unit head from base;

.2 relay type that is same as standard type but complete with auxiliary relay;

.3 audible type includes an audible alarm sounder;

.4 isolator type with line fault isolator.

2.10 PHOTOELECTRIC SMOKE DETECTORS

.1 Smoke detector to be addressable photo-electric type and to communicate digital equivalent of actual analogue smoke chamber values to system transponder.

.2 Detector's microprocessor measures and analyses signals and filters out signal patterns not typical for fires, thus limiting false alarms. microprocessor also performs:

.1 self-diagnostics and history logging, with results stored in non-volatile memory;

.2 automatic device mapping with supervision of each device location;

.3 identification of dirty or defective detectors;

.4 stand-alone operation if communications fail between it and main system CPU;

.5 on board intelligence which limits information required to be sent to main CPU.

.3 Sensitivity range of each detector set in transponder to be from 0.67-3.7% smoke obscuration. Each detector to have minimum five different programmable sensitivity levels within this range - 1.0, 2.0, 2.5, 3.0, and 3.5%.

.4 Detectors feature:

.1 Low profile design and ULC Listed for both ceiling and wall mount applications.

.2 Tamper resistant features.

.3 Electronic addressing.

.4 Electronics immune from false alarms caused by EMI and RFI.

.5 Insect screen.

.6 Environmental compensation.

.7 Automatic day/night sensitivity adjustment.

.8 RED/GREEN status LED indicators.

.5 Detectors to be equipped with a dust-bag, which is removed at time of verification, to prevent dust and dirt entering smoke chamber during construction.

2.11 DUCT TYPE SMOKE DETECTORS

.1 Duct type smoke detector units with features as follows:

.1 addressable photoelectric detector features;

.2 duct air sampling tube of suitable required length;

.3 magnetic activated test switch;

.4 status LEDs;

.5 form C auxiliary alarm relays;

.6 remote alarm indicator assembly with LED type lamp and single gang stainless steel faceplate;

.7 remote test station for detectors in locations not easily accessible to test.

.2 Duct housing assembly to consist of air tight housing mounted on side of duct. This housing to contain detector base into which photoelectric detector head is inserted.

.3 For units located within ductwork as shown on drawings and for units within air intake ductwork provide ULC listed and labelled weatherproof housing complete with integral heater and thermostat control with alarm contacts for monitoring and annunciation of low temperature. Provide wiring in conduit back to transponder/control panel.

2.12 THERMAL DETECTORS

.1 Thermal detectors to be addressable unit of following types:

.1 fixed temperature 57°C (135°F) detector type;

.2 combination 9C° (15F°) per minute rate of rise / 57°C (135°F) fixed temperature detector type.

.2 Detector's microprocessor measures and analyses signals and filters out signal patterns not typical for fires, thus limiting false alarms. microprocessor also performs:

.1 self-diagnostics and history logging, with results stored in non-volatile memory;

.2 automatic device mapping with supervision of each device location;

.3 tamper resistant features;

.4 stand-alone operation if communications fail between it and main system CPU;

.5 on board intelligence which limits information required to be sent to main CPU.

.3 Detectors feature:

.1 Low profile design and ULC Listed for both ceiling and wall mount applications.

.2 Tamper resistant features.

.3 Electronic addressing.

.4 Electronics immune from false alarms caused by EMI and RFI.

.5 Insect screen.

.6 RED/GREEN status LED indicators.

2.13 FLAME DETECTORS

.1 Ultraviolet type flame detectors as follows:

.1 flame detector to be addressable and to be suitable for intended application of area of coverage;

.2 compact unitized package consisting of detection tube, encapsulated solid state circuitry, dry contact Form C alarm relay;

.3 spectral sensitivity range: 1700 to 2900 angstroms;

.4 temperature range: -25°C to 60°C (-14°F to 140°F);

.5 general purpose painted steel enclosure with protective cage guard;

.6 explosion proof housing for specific applications in hazardous classified locations as reviewed with Contract Administrator;

.7 addressable module, ancillary relays and accessories as required for connection to system panel.

2.14 LINEAR HEAT DETECTION CABLE

.1 Safe Fire Detection, "SafeCable", or approved equal, ULC listed and labelled, linear heating line-type form of fixed temperature heat detection to detect a fire anywhere along its entire length and is available in multiple temperatures from 68°C to 178°C.

.2 Provide cable rating to suit specific applications confirmed with cable manufacturer and reviewed with Contract Administrator.

.3 Cable consists of:

.1 twisted cable of low resistance rating of 0.164 ohm/m (0.05 ohm/ft);

.2 tri-metal core – steel, copper and tin;

.3 thermal reactant sheathing – polymers providing temperature specific activation;

.4 PVC outer covering – chemical resistant, UV resistant, outdoor rated use;

.5 flexible 3.2 mm (1/8") dia wire.

.4 Miscellaneous

.1 Distance locating module with display screen indicating distance to locate where over heating condition is occurring.

.2 Guidewire for support of long spans.

.3 Nylon and polypropylene outer jackets to suit specific applications; review with CONTRACT ADMINISTRATOR.

.4 Junction boxes, strain reliefs, end-of line resistors and mounting hardware, as required.

2.15 AUDIBLE/VISUAL DEVICES

.1 Devices include horns/speakers, strobes and combination units. Audible devices for same applications, to sound alike on system as approved by local governing authorities. Devices to mount on wall back boxes. Back boxes to be supplied by system manufacturer to suit specific devices and type of installation. Confirm finish colours with The City and review with Contract Administrator prior to ordering.

.2 Audibility levels and candela levels of devices to be field selectable and adjustable to suit local codes and standards for various applications, such as sleeping rooms. Subject to review with Contract Administrator, system vendor to select and adjust levels as required to meet local governing authority and code requirements for final installed system. Audible and visual devices to be of similar sound and pattern.

.3 EVC Cone Speakers:

.1 In finished areas provide a 114 mm (4.5") cone-type speaker with round enamel painted steel baffle suitable for ceiling or wall mount applications. Speaker assembly to consist of following:

.1 fire retardant and moisture proof cone rated 15 watts;

.2 25/70 volt matching transformer complete with 1/4, 1/2, 1 and 2 watt taps;

.3 220 grams magnet;

.4 80 HZ to 13,000 HZ frequency response;

.5 94 db at 1.2 m (4'), with a 1 watt input;

.6 moisture repellent treated steel enclosures;

.7 pre-tap speakers at 1/2 watt tap.

.2 For integrated speaker strobe units include with above EVC speaker, integral synchronized strobe with Lexan lens, field changeable "FIRE" markings and candela output intensity as approved by local fire authority (range from 15 cd to 110 cd, and to 177 cd for specific applications).

.4 For mechanical rooms and non-climate controlled areas: Re-entrant type speaker and speaker/strobe units with following features:

.1 outdoor rated, weather-resistant;

.2 temporal or continuous tones to meet local governing authority requirements;

.3 sealed high compression driver with DC blocking capacitor for audio supervision;

.4 2 watt to 15 watt taps and 90 dbA @ 3 m (10') at 2 watt tap;

.5 faceplate of impact resistant and weather-resistant red or white Noryl construction; review final finish colour with Contract Administrator;

.6 integral synchronized strobe to be complete with Lexan lens, field changeable "FIRE" markings and candela output intensity as approved by local fire authority (range from 15 cd to 110 cd, and to 177 cd for specific applications);

.7 weather-proof back box suitable for surface or flush mounting applications to suit required installation requirements.

.5 Stand alone strobes to be similar to features of combination units specified above but only with strobe features, typically:

.1 synchronized, suitable for intended application with input polarized for standard reverse polarity supervision by fire alarm controls;

.2 designed with zero inrush current at 15, 30 and 110 candela intensities, and to 177 cd for specific applications;

.3 exact intensities to be to fire authority requirements and as reviewed with Contract Administrator.

.6 In finished areas, devices to mount to a 100 mm (4") square, 60 mm (2-1/8") deep, back box. Where devices are to be surface mounted, provide red or white finished surface back box with no knockouts.

.7 Devices mounted exterior to be complete with "weatherproof" box and tamperproof and weatherproof hardware..

2.16 END-OF-LINE RESISTORS

.1 End-of-line resistors for standard alarm and signalling circuits to be sized to ensure correct supervisory current flows in each circuit, as per local governing code requirements and system manufacturer's recommendations.

.2 End-of-line resistors to be mounted on impact resistant nylon plate or stainless steel for mounting on a standard single gang box and bear ULC label.

2.17 ISOLATORS

.1 Isolators to be provided in accordance with local governing code requirements and installed as per system manufacturer's requirements to isolate/monitor zones, loops, group of devices within building and between buildings.

2.18 WIRING

.1 CSA approved and ULC listed wire and cable, approved for fire alarm circuits; with colour coded, insulated solid copper conductors; of type as per local governing electrical code and local governing fire authority requirements; sized and installed in accordance with system manufacturer's instructions.

.2 nVent "Pyrotenax" type "MI" ULC listed and labelled, and 2-hour fire rated, mineral insulated, copper sheathed, copper conductors:

.1 for power, control and signal wiring as required by local codes and local governing authority required applications with regards to life safety equipment;

.2 for applications as indicated, and as reviewed with Contract Administrator;

.3 to and between each transponder/control panel, as required;

.4 for addressable device circuits, as required.

2.19 WARRANTY

.1 Warranty to include following:

.1 2 year repair or replacement warranty on components;

.2 warranty to begin upon substantial acceptance of project, or where applicable, phase of project; provide extended warranty for system if used during construction stages and which to cover period of construction before turn over to The City;

.3 support of an operational remote maintenance capability;

.4 repair response times for problems defined as routine to be addressed and corrected within 24 hours, excepting statutory holidays and weekends;

.5 repair response times for problems defined as major to be addressed and corrected within 4 hours, excepting statutory holidays and weekends;

.6 manufacturers of major components to provide written confirmation of full warranty, extended warranty and service back-up in case of failure to perform or insolvency of successful supplier;

.7 maintain maintenance records for each system supplied, and must submit a monthly report containing a time and date record of reported or detected problems, detail of corrective action taken and cause of problem.

2.20 SPARE PARTS

.1 Include for:

.1 5 manual stations;

.2 50 glass rods for manual stations;

.3 5 smoke detector of each type used;

.4 5 heat detectors of each type used;

.5 5 strobes of each type used;

.6 2 tamper switches (valve supervisor) of each type used;

.7 5 control switches of each type used;

.8 5 indicator lamps of each type used:

.9 one amplifier;

.10 5 EVC speaker assemblies;

.11 one zone addressable module of each type used;

.12 one modular control board of each type used;

.13 one power supply unit of each type used;

.14 3 fuses of each type used;

.15 5 end of line resistors;

.16 5 isolators.

2.21 ADDITIONAL DEVICES

.1 Include for 5 additional EVC speakers and 5 additional strobe lights, each with 20 m (60') of wiring in conduit, installation, programming, testing and verification. Install these additional devices in event of local fire/building inspector requiring additional coverage in certain areas.

2.22 ACCEPTABLE MANUFACTURERS

.1 Acceptable manufacturers (products and work to be provided directly from manufacturer, unless otherwise noted):

.1 Edwards (from Troy Life and Fire Safety, or Chubb Fire Safety);

.2 Johnson Controls formerly Tyco-Simplex (4100ES) (from Johnson Controls Tyco Integrated Fire & Security);

.3 Siemens Building Technologies (XLSV) (from Siemens);

.4 Honeywell - Notifier (ONYX NFS2 3030) (from Notifier authorized regional vendor).

3 Execution

3.1 INSTALLATION – GENERAL

.1 Prior to start of Work as part of shop drawing submission process, review with system manufacturer following:

.1 device types to ensure that selected type is suitable for intended application on project;

.2 selection of audible and visual devices with field adjustable settings to suit various installation areas and applications and to meet local codes and standards including ULC S524;

.3 locations of devices to ensure proper operation and coverage are in compliance with requirements of local fire authorities;

.4 device mounting heights to ensure proper operation and coverage are in compliance with requirements of local fire authorities;

.5 device back box requirements to ensure size and depth suit system manufacturer's recommendations for specific devices;

.6 types of system wiring and required sizing taking in consideration applications and voltage drop;

.7 system circuiting and device quantities per circuit while maintaining limitations in Specifications;

.8 proposed system sequence of operation.

.2 Immediately advise Contract Administrator of any requirements of above that may necessitate revisions to design documents.

.3 Provide fire alarm system for building in accordance with issued documents and to approval of local governing authorities. Install, test, verify, and certify system as per latest recognized standards indicated herein, local governing building code and as required by local governing fire authority.

.4 In addition, work to meet The City's standards, and recommendations and instructions from system and device manufacturers.

.5 Contact local governing fire authority and provide detailed description of Work. Confirm local governing fire authority exact requirements for Fire Watch and Fire Wardens for Work. Provide necessary requirements.

.6 Work in conjunction with this installation to meet requirements of latest editions of local governing building code, local governing electrical code, ULC Standards including Installation Standard CAN/ULC-S524, and any applicable local governing codes. If any requirements of these specifications are different, omitted or contrary to ULC-S524 Standard, then ULC Standard governs and overrides these specifications, but in no instance will standards established by drawings and specifications be reduced by any of Codes referred to previously. Control units and annunciators to be in accordance to latest requirements of ULC Standard CAN/ULC-S527 "Control Units for Fire Alarm Systems.

.7 Obtain required training from manufacturer's representative on any special installation procedures. Install system equipment, devices and perform work in accordance with manufacturer's instructions and requirements and in accordance to applicable codes of governing authorities having jurisdiction.

.8 Fire alarm system manufacturer's authorized technician to perform control panel, transponder, and annunciator work, including system programming. Fire alarm system manufacturer's authorized technician to inspect any related work by electrical contractor.

.9 Include for manufacturer's authorized representative to perform specified on site software programming sessions for The City's changes, to system after total completion of work and verification of system.

.10 Provide sequence of operation for fire alarm system as approved by local fire authority and reviewed by Contract Administrator. The City's fire Contract Administrator to also be contacted with regards to requirements of sequence of operation. Sequence of operation and proposed graphic displays to be submitted to local fire authority for approval and reviewed with Contract Administrator as part of shop drawing submissions. Refer to additional requirements on drawings.

.11 Demonstrate system to local Fire Department and obtain their approval for complete system.

3.2 SEQUENCE OF OPERATION

.1 For pricing purposes and which must be confirmed and approved by local authority having jurisdiction and reviewed with Contract Administrator, fire alarm sequence of operation to include but not be limited to description in following paragraphs.

.2 System to be flexible to easily program any sequence of operation. Control panel to be able to be programmed to initiate a series of pre-defined control actions. Review exact sequence of operation with Contract Administrator and local fire authority prior to programming. Review fire plan prepared by Fire Contract Administrator. Sequence herein is provided as an outline with exact requirements to be confirmed and programmed to requirements of fire plan, authority having jurisdiction and reviewed with Contract Administrator. Include for programming and software re-burning within 30 days of initial burning or within duration as directed by local authority having jurisdiction, and also for additional software reprogramming periods as previously specified. Generally, activation of any alarm initiating device including sprinkler system alarm valves in areas to cause:

.1 fire alarm signal tone to sound a first stage fire alert signal as approved by local fire authority, throughout zones as scheduled on drawings or as required by local fire authority, for at least five minutes;

.2 address and zone of fire alarm initiation to register on annunciators;

.3 activation of circuitry to transmit an alarm signal to device(s) provided by others (The City's arranged monitoring company) to send alarm signal to Fire Department or to an outside private protection company; this work to comply with CAN/ULC-S561;

.4 smoke and fire doors as scheduled, in building which are normally held open by electric door holders to be released and closed, locked doors controlled by electric door locks and/or magnetic door locks to be opened and remain opened until fire alarm system is reset;

.5 a signal sent to automatic temperature controls of air handling systems to initiate sequence of operation of air handling equipment to operate;

.6 a signal to be sent to smoke control equipment such as designated fans as scheduled to operate or shut down or dampers to open or close and pressurization fans as scheduled to automatically start;

.7 alarm condition to be displayed on alphanumeric display on CPU and on remote annunciators;

.8 activation of assigned control points through control-by-event;

.9 assigned message and activated control-by-event functions, with time and date, for monitored point in alarm to be logged in system memory;

.10 colour graphic to show on screen layout of floor and zone area in alarm;

.11 homing elevator to 1st level or designated level automatically; elevators to operate in emergency sequence of operation;

.12 indicate alarm details in remote annunciators;

.13 log alarm/trouble events in historical event log;

.14 illuminated fire signs to be operated at fire alarm zones where they occur;

.15 visual notification appliances (strobe lights) to activate in applicable zones;

.16 associated integrated low voltage systems to be signalled, as required; exact systems to be integrated to be as reviewed with Contract Administrator; emergency sequencing of other system to be initiated;

.17 integrated main fire alarm control units of other buildings of complex to be signalled, as applicable.

.3 System to remain in first stage alert for stated period, after which if alarm condition has not been acknowledged then second stage alarm condition to be automatically initiated. Manually silencing of first stage alert to be possible subject to written approval from local fire authority.

.4 Alarm conditions to be cleared and system reset only after activated alarm initiating device or devices on both stages of alarm have been restored to normal and building control panel is reset.

.5 Upon activation of fire alarm system, a signal to be sent to elevator controllers to implement emergency sequencing of cars. Generally, elevators to "home" to designated floor, unless alarm zone is on designated floor, in which case, elevators to stop at floor above. Exact emergency sequencing requirements to be as reviewed with Contract Administrator.

.6 Voice communication system to include provision for silencing alert signal and alarm signal when voice messages are being transmitted, but only after alert signal has sounded for at least 30 seconds.

.7 Unauthorized closure of a fire protection system piping supervised valve to cause location of closed valve to be indicated at annunciators, trouble signals (audible and visual) to sound and illuminate, and a trouble signal to be transmitted to The City's fire alarm monitoring company. This work to comply with CAN/ULC-S561.

.8 Low pressure in fire protection piping mains (wet and dry), fire protection system pump (fire pump-standpipe system excess pressure pump-sprinkler pump and sprinkler system excess pressure pump) loss of power, sprinkler air compressor loss of power, generator fail to start, generator starting batteries low voltage or operation of fire pump to also activate audible and visual trouble alarm as specified above for supervised valves.

.9 Refer to drawing notes for additional requirements.

3.3 INSTALLATION OF CONTROL UNIT COMPONENTS

.1 Install control panels in locations. Mount equipment and connect complete. Arrange for manufacturer's authorized representative to program system with required sequence of operation. Sequence of operation to be as specified previously. Install required EVAC controls, associated panels and ancillary devices. Review exact locations with Contract Administrator prior to rough-in.

.2 Secure each panel enclosure to walls in accordance with manufacturer's instructions and connect with fire rated type conductors (MI) per local governing code and local governing authority requirements. Coordinate location and installation requirements with trade responsible for wall finishes and review with Contract Administrator.

.3 Connect panels/transponders to dedicated circuit breakers in nearest emergency panel as shown or as scheduled. Ensure that room housing panels have fire rating to local governing code requirements. Connect with fire rated type conductors (MI) per local governing code requirements and local governing authority requirements.

.4 Install electromagnetic lock control consisting of master reset switch and release switch onto control panel as required. Provide required wiring in conduit and relays and connect to electromagnetic door locks tom provide required operation of resetting and release. Coordinate with trades responsible for providing electromagnetic locks, and ensure requirements are provided in compliance with local governing authorities.

.5 Properly ground and bond equipment and required components to building ground. Conduit ground will not be acceptable. Provide green coloured grounding loop, a minimum #10 AWG insulated copper run in conduit. Connect ground loop to main building ground system source. Do not run ground wire in same conduit as fire alarm and communication wiring.

3.4 INSTALLATION OF DEVICES

.1 Install required devices. Do not install devices in locations that may hamper proper operation of devices including adjacent devices.

.2 Install devices and perform work in accordance with manufacturer's instructions and requirements specific for their devices. Review device finishes with Contract Administrator prior to ordering.

.3 Install manual stations in boxes as required, recessed outlet boxes with plaster rings, except in unfinished areas where stations are surface mounted, in which case, install stations in surface mounted boxes. Comply with mounting height requirements for local governing building code barrier free access. Install covers as required.

.4 Install mounting plate of thermal detectors to ceiling mounted boxes as required. Secure detectors to plates. Refer to floor plans and drawing symbol list to determine rating of detectors in any given area. Generally, do not install rate-of-rise type detectors in areas subject to sudden changes in temperatures, such as entrance vestibules. Confirm application requirements with system manufacturer and ensure that devices are ULC listed for such applications and are approved by local fire authority for such use.

.5 Secure base of each ceiling mounted products of combustion detectors to boxes as required, either flush or surface mounted as required. Secure detector heads to bases.

.6 Install cross zoned connection of detectors and remote indicating devices for areas of raised floors or within accessible ceiling spaces or for applications detailed on drawings.

.7 Mount each duct mounted products of combustion detector on duct in question and connect with smoke sampling tubes which extend into duct air stream. Install a remote alarm lamp assembly for each duct mounted detector. Wall mount each lamp assembly on a standard 100 mm (4") outlet box as close as possible or practicable to detector. Do not locate duct detectors within 1 m (3') of duct size increaser or decreaser fittings or any duct elbow. Provide wiring in conduit and extend to connect back to system control unit.

.8 In application with hold open devices on doors, ensure compliance with NFPA regarding smoke detectors tied to hold open devices such that a signal received directly from smoke detector to cause release of door. Where electromagnetic locks are used on doors of egress, provide required automatic release of locks upon activation of fire alarm (i.e. via connection to auxiliary contact of adjacent manual station). Provide required connections to fire alarm system and to electromagnetic locks.

.9 Provide CO detectors and mount onto recessed boxes in locations as required and as recommended by system manufacturer. Interconnect to other CO detectors in series with required module to sound integral sounders and to control panel to annunciate as trouble signal. Confirm sequence of operation with local governing fire authority prior to start of work.

.10 Work to include provision of fire alarm devices (flame detectors, smoke detectors, audible/visual devices) in genset enclosures. Refer to drawings for device types. Genset enclosure is constructed with conduits and boxes to accommodate these future fire alarm devices. Install required devices and wiring. Extend wiring from devices to enclosure termination box. Extend from termination box to main building and connect to fire alarm system. Coordinate work with genset enclosure vendor.

.11 Provide required audible/visual devices. Speakers/strobes as reviewed with Contract Administrator for each area type, to be flush and surface mounted type as indicated and as coordinated to suit architectural wall/ceiling types, each complete with proper backbox and trim plate

.12 Wire speakers/horns in Class B, 2 wire circuit configuration, terminating in end of line devices. Wire alternate speakers in same circuits with minimum of 2 circuits per floor.

.13 Mount speakers/horns/strobes in stairwells and wire vertically connected to specific zone as approved by local fire authority and reviewed with Contract Administrator. Refer to drawing riser and annunciator schedule.

.14 Provide required horns and combination horn/strobes as reviewed with CM for each area type. Horns/strobes are flush and surface mounted type as indicated to suit architectural wall/ceiling types, each complete with proper backbox and required trim plate.

.15 Exterior speakers and horns to be weatherproof and vermin resistant and mounted with weather sealed gland nut connection at proper dispersion angle.

.16 Generally, audible device locations are indicated on drawings, however, exact audible device quantities and locations to be in accordance with results of audibility device coverage site tests. Provide suitable sound detection metering and personnel to make necessary tests. Relocate audible devices and/or provide additional audible devices as required.

.17 Support flush ceiling mounted speaker backboxes from structure and not suspended ceiling grid or tiles. Connect speakers to specified taps and ensure that sound levels are in accordance with local authority and sound level requirements. Adjust as required and certify that levels comply with applicable code level requirements. Audible devices to be synchronized.

.18 Typically, install visual notification appliances 2400 mm (8') above floor or 300 mm (12") below finished ceiling line. Provide visual notification devices in areas subject to high ambient noise levels, such as mechanical equipment rooms, computer equipment rooms, parking garage, etc., and areas designated for hearing impaired as per local building code requirements. Provide minimum 2 circuits per floor and connect devices in alternating scheme.

.19 Install amplifiers sized as required to power speakers and include spare capacity as specified.

.20 Install specified telephone handsets and mount in recessed wall mounting boxes. Connect complete with wiring in conduit to local transponder.

.21 Provide double voltage relays, with multiple contacts as required, to shut down fans as noted on drawings. Arrange relays to be energized at all times from fire alarm system to ensure that they are fail safe.

.22 Install paging microphone within CACF room and in other locations as required. Review locations with Contract Administrator.

.23 Install fire signs in locations as reviewed with Contract Administrator and connect such that activation of fire alarm system illuminates sign and when system is reset and alarm has been silenced, sign is de-energized.

.24 Install and circuit devices in accordance with manufacturer's instructions for specific applications and in accordance with referenced ULC S500 device standards and requirements of local governing authorities. Unless otherwise noted in Contract Documents and reviewed with Contract Administrator, do not load device circuits more than 80% capacity.

.25 Devices in non-climate controlled areas to be weatherproof, corrosion resistant, ULC listed for operation in below freezing temperatures, and as recommended by system manufacturer for use for each specific application. Where electronics are not recommended for cold temperature applications, include for manufacturer's recommendations and directions in remotely locating addressable modules in closest heated areas and connecting to respective device in non-climate controlled areas.

3.5 REQUIREMENTS FOR INTEGRATED SYSTEMS AND EQUIPMENT

.1 Provide voltage sensing relays in all the phases, line side, of the fire pump controller and standpipe system excess pressure pump starters to sense loss of line voltage. The relays shall be energized from 15 A 1P breakers and shall be complete with "C" contacts, one per phase, which, if any one phase voltage drops below 90% of nominal, trouble alarm shall signal in the fire alarm system indicating "Fire Pump Loss of Voltage" or "Standpipe Excess Pressure Pump Loss of Voltage" at all annunciators.

.2 Provide auxiliary N.O. contact in the fire pump controller and connect to the fire alarm annunciators, powered from the fire alarm system to indicate "Fire Pump Running".

.3 Perform required fire alarm system wiring connections to mechanical equipment and other building systems to perform required interrelated functions. Provide required wiring, relays and/or contactors between fire alarm system and various equipment to achieve automatic or manual control of equipment, to perform required integrated to fire alarm system functions. Provide shunt trip breakers as required. Provide fire rated conductors where required by local codes and local authorities.

.4 Provision of fire alarm supervisory wiring connections to include but not be limited to following (where applicable):

.1 fire protection system piping supervised valves and flow switches for alarm initiation;

.2 fire protection system piping supervised valves and flow switches for trouble indication;

.3 fire protection piping pressure detectors for loss of pressure trouble indication;

.4 fan equipment starters;

.5 pumps;

.6 dampers;

.7 fire suppression systems;

.8 door holders/releases and electromagnetic locks;

.9 telephone system key switch/PBX for connection to offsite central monitoring station;

.10 telephone system key switch/PBX for connection to allow for integrated general paging with voice communication system;

.11 fire pump transfer switch;

.12 security systems;

.13 BAS system;

.14 dimming systems to initiate emergency operations;

.15 background music systems and sound systems to mute in event of emergency paging;

.16 genset control panel for annunciation of "Genset Running", "Failure", "Genset Battery Low Voltage" and "Genset Low Fuel";

.17 central inverter system for emergency lighting;

.18 devices and equipment as shown on drawings.

.5 Provisions for elevators to include but not be limited to following:

.1 minimum 5 dry contacts, one for connections to smoke detectors in lobbies, machine rooms and hoisting, one for connection to smoke detector activated at designated return landing; and others for auxiliary contacts for use as confirmed with Division 14; include relay type bases as required for detectors; increase number of contacts as required and coordinated with elevator trades;

.2 conduit and wiring from fire alarm control panel to each elevator;

.3 controller; confirm exact requirements with Division 14.

.6 Interconnect fire alarm system to security system to provide a common "Alarm" signal to security system controls to release locked doors (designated by The City) throughout the building on any or designated alarm condition. Interconnections between local fire alarm manual stations and local security system components door hardware to be provided in this manner. Coordinate work with respective system vendors and door hardware trade. Provide manual control switches for release and reset and mount onto control panel. Clearly label operators. Comply with local governing authorities regarding these requirements. Coordinate with Contractor to obtain required Certificates of Approval for Work.

3.6 ADDITIONAL REQUIREMENTS

.1 Provide required system wiring in accordance with local governing code requirements, system manufacturer’s recommendations and based on specific applications and consideration of voltage drop.

.2 Install wiring in conduit unless otherwise approved by The City and reviewed with Contract Administrator, and except for MI fire rated type. Perform wiring connections associated with fire alarm system on terminal strips in junction boxes and colour coded. Splices are not permitted. Ensure that wiring colour coding is consistent for entire length of each run. When pulling wires into conduit, use lubricant and ensure that wires are kept straight and are not twisted or abraded. Neatly secure exposed wires in apparatus enclosures with approved supports or ties. Clearly identify wiring at each termination point. In addition, number wiring with Brady Ltd. or Electrovert Ltd. Z-type markers. Colour conductors for each part of system in accordance with system equipment manufacturer's recommendations. Paint conduit couplings red of paint type suitable for application to standards of Division 09.

.3 Install wiring in accordance to requirements latest edition of applicable governing electrical code and to requirements of local governing authorities.

.4 Where required by local governing codes and/or local governing authorities, provide ULC listed, fire rated conductors (MI) for connections to and interconnections between equipment for life safety applications requiring fire rating. Install MI type conductors in accordance with manufacturer's instructions and requirements in Specification.

.5 Run alarm indicating circuits (speakers/strobes/horns) and alarm receiving circuits (manual stations, detectors) in separate conduits from each other.

.6 Arrange sprinkler system alarm valve alarm zones to be separate from manual station, thermal detector and products-of-combustion detector device zones, which may be connected together into zones.

.7 Provide engraved Lamacoid identification nameplates for each equipment or wiring housing and secure to front of housing. Exact wording designations and sizes to be reviewed with Contract Administrator prior to manufacture. Label devices as required by ULC S524 and local governing authorities.

.8 Review nomenclature of annunciator identification with Contract Administrator and obtain necessary approvals prior to ordering.

.9 Install end-of-line resistors to electrically supervise wiring. Generally, locate end-of-line resistors at ceiling lines above a manual station location or in equipment rooms as reviewed with Contract Administrator. Provide isolators and install in accordance with ULC standards. Properly label and identify. Do not locate end-of-line resistors and isolators in concealed locations. Generally install in equipment rooms.

.10 Refer to drawing riser diagram. Riser drawings are diagrammatic and are not to be used for determining quantities or lengths. Quantities of components to be as per floor plans. Determine exact quantities of circuits based on drawings information, connected devices, requirements of governing codes and standards, and recommendations of system manufacturer.

.11 Review exact location of components with Contract Administrator prior to roughing-in.

.12 Perform required training and instructions to The City's staff.

3.7 INSTALLATION OF STANDALONE LINE VOLTAGE DETECTORS

.1 Install units in locations as required following manufacturer's instructions to suit installation applications. Interconnect as required by local governing codes.

.2 Provide suitable junction boxes.

.3 Provide dedicated breaker circuits with locking tabs. Do not exceed local governing code or manufacturer's recommended number of devices per circuit.

.4 Test units after installation is complete.

3.8 SYSTEM TESTING, VERIFICATION AND CERTIFICATION

.1 Submit to The City and Contract Administrator, proposed schedule for testing and verification of system. Obtain such reviews prior to start of testing. Contract Administrator and/or other The City's representatives to have option to witness all or part of testing and verification work. Notify Contract Administrator and The City minimum 7 working days in advance of testing.

.2 Include for fire alarm system manufacturer to inspect, test, verify and certify system components and wiring, individually and as a complete system, in accordance with requirements of latest edition of CAN/ULC S537 and CAN/ULC-S1001. Work to include but not be limited to following:

.1 to ensure that type of equipment installed is that designated by Contract Documents;

.2 to ensure that wiring connections to equipment components show that installer observed ULC and CSA requirements;

.3 to ensure that equipment was installed in accordance manufacturer's recommendations, and that signalling devices of whatever manufacture were operated or tested to verify their operation;

.4 to ensure that supervisory wiring of those items of equipment connected to a supervised circuit is operating and that governmental regulations, if any, concerning such supervisory wiring, have been met to satisfaction of inspecting officials;

.5 to ensure that sequence of operation is in accordance with specified building sequence of operation and any modifications identified on documents and are approved by local fire authority;

.6 to ensure that devices are commissioned and operable.

.3 System manufacturer to also be responsible for but not be limited to following:

.1 confirm that connections to security system and third party monitoring party are in accordance with CAN/ULC-S561;

.2 coordinate with local fire authority inspector and Electrical Division Contractor, required testing and verification work in order to obtain certification and meet local fire code and local fire authority requirements;

.3 verify fire alarm system on a zone by zone basis, and verify entire system in whole, at completion of installation;

.4 test system battery power supplies and demonstrate compliance with local governing building code and local fire authority requirements that battery supplies are capable of providing required duration of supervisory power followed by local governing building code required time (or time directed by local fire authority) of full load power; exact method of testing to be approved by local fire authority and The City, and reviewed with Contract Administrator; confirm exact procedures with previously named parties prior to testing; include for sufficient sound measurement devices and personnel in order to successfully comply with this requirement;

.5 full review, testing, and verification of operation of building ventilation and smoke exhaust system and its integrated operation with fire alarm system and various pieces of air handling equipment;

.6 full review, testing and verification of operation of integrated systems such as elevators and their emergency sequence of operation, supervisory annunciation of sprinkler/standpipe monitor switches, pressure switches and flow switches, diesel genset alarms, security alarms, BAS alarms, release of door holders and electromagnetic locks, and any other integrated components; coordinate requirements with trades responsible for integrated components and systems who will be present at time of testing and verification work;

.7 test that system audible devices provide alarm sound levels in areas as per local governing building code and local fire authority requirements; site adjust tap settings of audible devices as required to achieve required audibility levels; also test that emergency voice communication system meets or exceed requirements of local governing building code and is approved by local fire authority;

.8 assist in Testing and Verification of electromagnetic door locks to meet requirements of authorities having jurisdiction and to obtain overall approval of installation;

.9 coordination with Electrical Divisions and local fire authority to provide requirements needed to obtain certificates of approvals from local fire authority.

.4 Where project work is phased and The City requires occupancy at various stages, include for providing system testing, verification and certification after completion of each phase of work, to approval of local governing authorities. Upon Substantial Performance of the Project Work, include for providing system testing, verification and certification of the entire system work.

.5 Contact local fire authority inspector and coordinate and arrange for Fire Inspector to perform required inspections. Integrate local fire authority inspection requirements with testing and verification work to extent as per Fire Inspector’s directions. Obtain full approval and certification by local fire authority.

.6 Local fire authority inspector, Contract Administrator and Commissioning Agent to at their discretion test system or parts of system in their review of test reports. Correct/repair any failures or deficiencies found in system, whether or not identified in test reports of manufacturer. Re-test and re-verify failures and deficiencies until successfully passed, at no extra cost to The City.

.7 Obtain from local fire authority required certificate of approval of system and forward to Contract Administrator.

.8 Arrange for manufacturers to supply reasonable amounts of technical assistance with respect to any changes required to conform to paragraphs above. During period of inspection, testing and verification, make Electricians available to do any required correction work and to assist during this Work. Include for trades responsible for integrated components (i.e. exhaust fans, sprinklers, elevators, gensets, etc.) and systems to be present at time of testing and verification work.

.9 Provide full detailed test sheets of tested components and provide certification that system work has been fully tested, that devices have passed testing and that system is in proper work order in compliance to local governing code requirements and project documents. Documentation to be in form in compliance with referenced standards, acceptable to local governing authority having jurisdiction and reviewed with Contract Administrator. Testing report documents to be additionally provided in electronic format as reviewed with local governing authority having jurisdiction and Contract Administrator.

.10 On completion of verification, inspection and testing of system, obtain from manufacturer and forward to Contract Administrator, a verification certificate together with detailed inspection reports listing each and every system component, its location in building and its acceptability. Verification certificate and inspection reports to be prepared and signed by certified testing technicians of manufacturer. Signed test reports to confirm that systems are installed and perform in accordance with requirements specified above.

.11 Obtain from system manufacturer and testing agency and forward to Contract Administrator a certificate of liability insurance of minimum amount of Two Million Dollars ($2,000,000.00) CDN that is to be registered for this project to show satisfactory proof of manufacturer's liability coverage for both their product and personnel.

.12 Do not use open flame and/or smoke for testing unless approved by The City and reviewed with Contract Administrator.

.13 Testing technicians to be registered technicians in good standing with Canadian Fire Alarm Association (CFAA) or be a Certified Fire Alarm Electrician (CFAE) with Electrical Contractors Association of Manitoba (ECAM) as deemed acceptable to Manitoba Fire Marshall.

.14 Submit with test reports, copies of valid certification of testing company and technicians.

.15 Refer to additional requirements of Section entitled Electrical Work Analysis and Testing.

3.9 TRAINING

.1 Manufacturer's trained technician to perform onsite training of each user (including provision of user guides) prior to project completion to ensure that users are properly trained in operation and maintenances of system.

.2 Refer to Instructions to The City specified in Section entitled Electrical Work General Instructions.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 31 62 13 Precast Concrete Piles

.2 Section 31 61 13 General Requirements for Pile Foundations

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM):

.1 ASTM D4945-17, Standard Test Method for High-Strain Dynamic Testing of Deep Foundations

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit outline of test method to be employed and include drawings showing details of test set up 7 days before testing.

.3 Site Quality Control Submittals:

.1 Test reports: Submit dynamic test reports for piles from qualified professional.

.1 Indicate: Compliance with specified performance characteristics and physical properties.

.2 Prepared, signed and sealed by a qualified professional in accordance with Section 01 43 00 – Quality Assurance.

1.4 QUALITY ASSURANCE

.1 Contractor shall retain a qualified Testing Agency with minimum 5 years of related experience to perform pile testing. Testing shall be supervised and analyzed by a Professional Engineer licensed in Manitoba with minimum 5 years of related experience.

1.5 DESIGN CRITERIA

.1 Capacities: Factored Resistance as indicated on Drawings.

.2 Refer to the geotechnical investigation report prepared by AECOM included in the appendices.

2 Products

NOT USED

3 Execution

3.1 PREPARATION

.1 Supply and erect all apparatus, equipment, structures, protective structures, and lighting required for testing procedure.

3.2 TESTING

.1 Site Tests: To be performed in presence of the Contract Administrator.

.1 Contract Administrator to select piles for testing at beginning of Work.

.2 Perform dynamic tests and prepare reports in accordance with ASTM D4945 except as specified.

.3 The dynamic tests shall be conducted using the piling contractor's pile driving equipment and test equipment provided by the Testing Agency. Piling contractor shall provide access to facilitate installation of test equipment and ensure that no damage is done to the testing equipment.

.4 Preconstruction Wave Equation Analysis

.1 After the Contractor had submitted specifications for the pile driving equipment, the Testing Agency shall use the submitted information to perform wave equation analysis and shall prepare a summary report of the wave equation results. The wave equation analyses shall be used to assess the ability of the proposed driving system to safely install the pile to the required capacity and/or desired penetration depth within the allowable driving stresses. Submit results of the analysis to the Contractor Administrator.

.2 Approval of the proposed driving system by Contract Administrator shall be based upon the wave equation analyses indicating that the proposed driving system can drive the pile to achieve the required static pile capacity of at least 2.0 times the pile design capacity at a driving resistance not greater than the practical refusal, within allowable driving stress limits for the pile material.

.3 The Testing Agency shall provide initial recommendations that will achieve the desired capacities as indicated on the drawings.

.4 A new pile driving system, modifications to existing system, or new pile installation procedures shall be proposed by the Contractor if the results of the wave equation analysis indicate that the required capacity is not achieved, excessive blows are required or driving stresses exceed the maximum allowable limits.

.5 Dynamic Tests

.1 The piles selected for testing should be representative of other piles in the same structure.

.2 The Testing Agency shall perform 2 initial tests for the first 10 piles. The Testing Agency shall provide final recommendations that will achieve the desired capacities as indicated on the drawings.

.3 Perform One test for each 50 piles afterwards (total 2% of all piles). Number of piles to be tested may be adjusted depending on the test results.

.4 Piles selected for testing shall be driven to attain static capacity of at least 2.0 times the pile design capacity. Adjustments to the preliminary driving criteria may be made by the Contract Administrator based upon the dynamic testing results

.5 Where driven piles exhibit lower driving resistance and/or shorter penetrations than normal, groundwater and/or installation conditions, additional tests over and above minimum number of tests specified earlier may be required. Further, additional tests should accompany changes in piling equipment, procedure and pile requirements.

.6 Remove apparatus and equipment on completion of test.

3.3 TEST EVALUATION:

.1 Interpretation of results for predicting pile performance and capacity shall be conducted by the Testing Agency's supervising professional engineer.

.2 Carry out additional load tests as directed by Contract Administrator if pile fails to sustain test load.

3.4 TESTING REPORTS

.1 Provide daily field reports to include the calculated driving stresses, transferred energy, and estimated pile capacity at the time of testing. Variations from previous trends in the dynamic test data shall also be noted.

.2 The Testing Agency shall prepare and submit a written report not later than 7 days after the test completion. This report shall include the results of dynamic tests and shall include the pile capacity obtained from the dynamic testing. The report shall also include hammer and driving system performance, driving stress levels, and pile integrity.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 00 – Cleaning and:

.1 Remove all apparatus, equipment, structures, protective structures, and lighting that were required for testing procedure.

.2 Manage waste in accordance with Section 01 74 19 – Waste Management and Disposal.

END OF SECTION

1 General

1.1 WORK INCLUDES

.1 The below items are incidental to the Contract Price (Lump Sum) and are not payable as a Unit Price Item.

.1 Excavation for pile caps, void form, pile pre-boring and interior and exterior grade beams.

.2 Excavation for automatic barrier fence gate(s), chain link fencing and gates, metal fencing and gates, exterior and interior signage(s) and utility lines and hardware.

.3 Backfill within the footprint of the proposed building structure.

.4 Backfill under the proposed approach slabs around the building, as indicated on Civil and Structural drawings.

.5 Backfill under exterior concrete equipment pads, as indicated on mechanical and electrical drawings and structural standard details.

1.2 REFERENCE STANDARDS

.1 City of Winnipeg's Standard Construction Specifications

.1 CW 3170-R3 – Earthwork and Grading.

.2 CW 1120-R1 – Existing Services, Utilities and Structures

.3 CW 1130-R4 – Site Requirements.

2 Products

2.1 Products

.1 Refer to City of Winnipeg's Standard Construction Specifications CW 3170-R3 and E16.

3 Execution

3.1 Execution

.1 Refer to City of Winnipeg's Standard Construction Specifications CW 3170-R3 and E16.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 This Section specifies requirements for constructing cement concrete walks.

1.2 REFERENCE STANDARDS

.1 CW 3310 – Portland Cement Concrete Pavement Works

.2 CW 3325 – Portland Cement Concrete Sidewalk

.3 Latest version of the American Society for Testing and Materials (ASTM) International Standards:

.4 Canadian Standards Association (CSA International)

.1 CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00- Submittal Procedures.

.2 Product Data: submit WHMIS MSDS

.3 Inform Contract Administrator of proposed source of materials and provide access for sampling at least 4 weeks prior to commencing work.

.4 If materials have been tested by accredited testing laboratory testing laboratory approved by Contract Administrator within previous 2 months and have passed tests equal to requirements of this specification, submit test certificates from testing laboratory showing suitability of materials for this project.

1.4 QUALITY ASSURANCE

.1 Concrete mixes and materials must conform to CW 3310.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials in accordance with Section 01 74 19 – Construction Waste Management.

2 Products

2.1 MATERIALS

.1 Concrete mixes and materials: in accordance with CW 3310.

3 Execution

3.1 GRADE PREPARATION

.1 Do grade preparation work in accordance with CW 3310.

3.2 GRANULAR BASE

.1 In accordance with CW 3310.

3.3 CONCRETE

.1 Obtain Contract Administrator’s approval of granular base prior to placing concrete.

.2 Do concrete work in accordance with CW 3325.

.3 Provide edging as indicated with 10mm radius edging tool.

.4 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to Contract Administrator can be demonstrated. Hand finish surfaces when directed by the Contract Administrator.

3.4 FIELD QUALITY CONTROL

.1 Minimum testing requirements for Contractor to demonstrate quality control:

- .1 Minimum compaction requirements for granular base is 100%SPMDD.
- .2 Concrete sidewalk:
  - .1 3 locations per 500 m of sidewalk.
  - .2 Minimum 3 cylinders per location to break at 7 days and 28 days.
  - .3 Slump and air test at each sampling location.

3.5 FINISH TOLERANCES

.1 Finish surfaces to within 3mm in 3m as measured with 3m straightedge placed on surface.

.2 The sidewalk shall be given a broomed texture.

.3 Concrete adjacent to all formwork shall be finished with a tool that produces a 5mm rounded edge and a smooth, horizontal surface with a maximum width of 50mm. All tooling shall be uniform and straight and shall be depressed no more than 1mm below the adjacent surface. Any ridges along the tooled marks shall be removed. Contraction and expansion joints shall not be finished with a tooled edge.

3.6 EXPANSION AND CONTRACTION JOINTS

.1 Expansion joints shall be constructed to the full depth of the sidewalk.

.2 Expansion joints shall be filled full depth with 12mm thick asphalt impregnated fibreboard joint filler material and shall be clean and dry at the time of construction.

3.7 ISOLATION JOINTS

.1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.

.2 Install joint filler in isolation joints in accordance with CW 3325.

.3 Seal isolation joints with sealant approved by Contract Administrator.

3.8 CURING

.1 Cure concrete by adding moisture continuously in accordance with CSA-A23.1/A23.2 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound as directed by Contract Administrator.

.2 Where burlap is used for moist curing, place two pre-wetted layers on concrete surface and keep continuously wet during curing period.

.3 Apply curing compound evenly to form continuous film, in accordance with manufacturer's requirements.

3.9 BACKFILL

.1 Allow concrete to cure for 7 days prior to backfilling.

.2 Backfill to designated elevations with material as directed by Contract Administrator.

- .1 Compact and shape to required contours as directed by Contract Administrator.

3.10 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 GENERAL

.1 CAN/CGSB 1.74, Alkyd Traffic Paint and Organic Solvent Based Traffic Paint.

.2 FED-STD 595B, Standard Paint Colours.

.3 Environment Canada (ED)

.1 Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations, SOR/2009-264

.4 Green Seal (GS)

.1 GS-11-2013, Standard for Paints and Coatings.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature and data sheets for pavement markings and include product characteristics, performance criteria, physical size, finish, and limitations.

.2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 43 – Archeological, Cultural and Environmental Procedures.

1.3 QUALITY ASSURANCE

.1 Applicator's qualifications: Perform Work of this Section by a company approved manufacturer and having specialized equipment suitable for type of work specified.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 – Closeout Requirements.

.2 Operations and Maintenance Data: submit information on materials relative to work of this Section for inclusion in operations and maintenance manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors, off ground, and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect specified materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.6 SITE CONDITIONS

.1 Sustainable Design Provisions:

.1 Seasonal restriction for high VOC content traffic marking coatings.

.1 Do not install Work of this Section outside of following environmental requirements without manufacturer's written acceptance:

.2 Traffic paint: Ambient air and surface temperature minimum 5 degrees Celsius and maximum 43 degrees Celsius. Maximum relative humidity 85%, wind speed is less than 60 km/h and no forecast of rain within 4 h of start of application.

.3 Traffic marking coating application between May 1st and October 15th is subject to seasonal use restriction and must not have a VOC concentration more than 150g/L.

2 Products

2.1 MATERIALS

.1 Paint and Markings:

.1 Organic solvent based, lead-free to CAN/CGSB 1.74.

.2 Paints: in accordance with Master Painter Institute (MPI) recommendation for surface conditions.

.3 Colours for Accessible Parking: to MPI listed, white border and international symbol and blue background for accessible parking pavement markings, PMS 293C supplied and installed by Hub Surface Systems.

.4 Colours for Traffic/Zone Marking: provide SRI Value higher than 40.

.1 EXT 2.1A LATEX ZONE/TRAFFIC MARKING.

3 Execution

3.1 EXAMINATION AND PREPARATION

.1 Verification of Conditions: verify conditions of substrates and surfaces to receive pavement markings previously installed under other Sections are acceptable for product installation in accordance with MPI instructions prior to pavement markings installation.

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Pavement surface: dry, free from water, frost, ice, dust, oil, grease, and other deleterious materials.

.3 Clean pavement surface and remove loose material.

.4 Prohibit traffic in work area, until Work of this Section is complete.

.5 Proceed with Work only after unacceptable conditions have been rectified.

3.2 EQUIPMENT REQUIREMENTS

.1 Paint applicator: approved pressure type mobile with positive shut-off distributor capable of applying paint in single, double, and dashed lines and capable of applying marking components uniformly, at rates specified, and to dimensions as indicated.

.2 Distributor: capable of applying reflective glass beads as overlay on freshly applied paint.

3.3 APPLICATION

.1 Pavement markings: lay out traffic lines and markings as indicated on the drawings and in accordance manufacturer's instructions.

.2 Unless otherwise approved be Contract Administrator, apply paint only when air temperature is above 10 degrees Celsius, wind speed is less than 60 km/h and no rain is forecast within next 4 hours.

.3 Apply traffic paint evenly at rate of 3 m2/L (150 sq. ft/gal).

.4 Do not thin paint unless approved by Contract Administrator.

.5 Symbols and letters to dimensions indicated.

.6 Provide adequate shielding or masking during spray application of traffic paint.

.7 Paint lines of uniform colour and density with sharp edges. Lines shall be of uniform colour and density. Paint markings to be within plus or minus 12 mm of dimensions indicated.

.8 Thoroughly clean distributor tank before refilling with paint of a different colour.

3.4 TOLERANCE

.1 Paint markings: within plus or minus 12 mm of dimensions indicated.

.2 Refinish ragged edges or lines incorrectly laid out. Remove incorrect lines. Make inconspicuous.

3.5 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion, remove surplus materials, rubbish, tools, and equipment.

.1 Remove material spilled during installation and leave work area tidy.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Construction Waste Management.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Supply and install temporary barricades and traffic cones to protect freshly painted line work from being marked or otherwise disturbed until after paint is dry.

.2 Repair damage to adjacent materials caused by pavement marking application.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.2 All references standards specified herein imply the latest edition of the standards.

1.2 SUMMARY

.1 Supply and install automatic barrier fence gates, includes operation components and other accessories to complete the requirement as indicated in this Section.

1.3 REFERENCES

.1 UL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

.2 CAN/ CSA C22.2 no. 247-92 – Standards for Operators and Systems of Doors, Gates, Draperies, and Louvers.

1.4 SYSTEM REQUIREMENTS

.1 Design barrier fence gate with mechanically locked when in vertical (up position), and the horizontal (down position).

.2 Design barrier fence gate with automatic bi-directional operation to allow traffic in both directions.

.3 Design barrier fence gate with below configuration:

.1 Remain gate in close position at all times.

.2 Provide access control system to control automatic operator to open the gate and grant access to enter the facility.

.4 Design operator able to manually raise and lower the gate.

.5 Design to provide safety edge at the bottom of fence to prevent hitting to the obstruction within the gate operating area.

.6 Design the gate unit to provide visual and audible notifications for intuitive process.

.7 Design barrier fence gate is able to operate as an individual standalone barrier with primary/ replica configuration for up to 15 m (49’-3”) in clear passage.

.8 Comply with UL325 and CAN/CSA C22.2 no. 247-92) standard conditions and requirements.

.9 Performance:

.1 Opening Time: 12 second to complete open operation.

.2 Closing Time: 12 second to complete close operation.

.3 Mean Cycles Between Failure (MCBF): Average 750,000 number of cycles.

.4 Operating Temperatures: -10 °C to 50 °C (14 °F to 122 °F) without optional heater.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Manufacturer and tradesmen executing the work of this Section shall have had a minimum 15 years continuous Canadian experience in successful manufacture and designing of work of type and quality shown and specified. Submit proof of experience upon Contract Administrator's request.

.1 Arrange a senior, qualified representative of the manufacturer visit at the job site to direct the work of this Section at all times.

.2 Erection of barrier fence gates shall be by workers certified by manufacturer, trained and experienced in type of work as specified.

1.6 SUBMITTALS

.1 Shop Drawings:

.1 Submit fully dimensional shop drawings to Contract Administrator showing construction, assembly, elevations, sections and interfacing with work of other Sections.

.1 Indicate the arrangement of hardware, electrical components and connections, wiring diagrams, operating mechanism and required clearances.

.2 No work of this Section shall be fabricated until shop drawings and all other related submittals, documentation, certifications and samples as required by this Section, have been reviewed by Contract Administrator.

.3 Details shall indicate metal thicknesses, fasteners and welds, all anchorage assemblies and components and erection details.

.2 Product Data: Submit product data information includes equipment description, dimensions, installation instructions, and manufacturer's technical manuals on each product to be used, including:

.1 Site preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.

.3 Installation methods.

.3 Samples:

.1 Submit to Contract Administrator for approval, samples of materials and components to be used in the systems, prior to fabrication of work together with name of manufacturer and technical literature. Submit 12" x 12" samples of chain link fence fabric in colour as selected by the Contract Administrator.

.4 Maintenance Data:

.1 Provide operation and maintenance data for incorporation into Maintenance Manual.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver equipment to job site in manufacturer’s original packaging to prevent damages, and with complete installation instructions.

.2 Store materials indoors in a controlled environment, protected from construction activities and debris.

1.8 WARRANTY

.1 Automatic Systems: Warrant its products against parts defects for a period of two (2) years from the date of invoicing. Exclude normal wear on finishes or damage that occurs due to abuse or misuse.

2 Products

2.1 MANUFACTURERS

.1 Specified product is based on Model BLG77M by Automatic Systems America Inc. Other manufacturers and products with similar function, profile, type, and performance may submit for Contract Administrator to review for acceptance.

2.2 DIMENSIONS

.1 Operator Dimensions:

.1 Height: 1133 mm (44-5/8”)

.2 Footprint: 762 mm x 762 mm (30” x 30”)

.3 Rotation axis height: 1010 mm (39-3/4”)

.2 Fence Dimensions: as indicated in drawings.

2.3 COMPONENTS

.1 Cabinet:

.1 Inner Frame: Steel, 16 mm (5/8”) thick, prefinished powder coat paint, colour orange.

.2 Enclosure Panels: Aluminum, 3 mm (1/8”), prefinished powder coat paint, colour orange.

.1 Design unit enclosure comply with IP 43 degree of protection.

.2 Provide lockable key cylinder for access door to the cabinet.

.2 Access Cover: Aluminum, 3 mm (1/8”) thick, prefinished powder coat paint, colour orange

.1 For access for electro-mechanical drive and electronic control units, with lockable key cylinder.

.3 Fence Support Structure and Frame:

.1 Extruded aluminum tube, standard aluminum finish, provide red and white reflective strips finish on supporting frames.

.4 Fence:

.1 Aluminum wire mesh attached to fence frames, fabricate fence panel in modular sections to width and height as indicated in the drawings.

.2 Provide fence top with barbed wires.

2.4 OPERATION

.1 Provide operator and barrier fence gate with an integrated mechanical locking mechanism.

.2 Opening Control:

.1 Card reader to active gate from restricted zone.

.2 Provide inductive loops on both sides of gate for safety and to activate the gate to open.

.3 Push button box

.4 Key switch

.5 Remote control transmitter/receiver

.6 Inductive loops for car or truck detection

.3 Automatic Mode:

.1 Remain close at normal state, in stand-by position to receive command to open when activate by access control devices or inductive loop.

.1 Close after configurable delay time.

.4 Power Failure:

.1 Allow manual operation using specific tools during power outage.

.2 Restore to automatic mode once power is restored.

.5 Emergency Operation:

.1 Configure barrier fence gate to remain open when emergency signal is active.

.2 Restore to automatic mode once emergency signal is off.

.6 Drive Unit:

.1 3-phase asynchronous geared motor combined with V-belt driven gear reducer and a crank-and-rod linkages.

.1 Variable-speed controller for progressive accelerations and gradual decelerations.

.7 Microprocessor-Based Controller:

.1 Equip with the following:

.1 Digital screen to facilitate the configuration of the barrier.

.2 LED indicator to show the inputs and outputs status.

.3 Fourteen (14) configurable digital inputs.

.4 Three (3) configurable output relays.

.5 Six (6) configurable digital outputs.

.2 Capable to accommodate any loop detector with dry contact outputs.

.3 Equip with an extension module to add eight (8) configurable inputs and eight (8) configurable output relays.

.4 Equip operating device with an ethernet connection module and one (1) SD card slot to store the usage log.

.8 Power Supply:

.1 208 VAC 3-phase 60 Hz

.2 Nominal consumption:

.1 At rest: 50W

.2 In operation:

.1 659W (without heater)

.2 1109W (with 450W heater)

.3 1459W (with 800W heater)

.9 Safety, Signal and Sign:

.1 Provide controller motor with entrapment protection devices in accordance with UL325 and CAN/ CSA C22.2-47 requirement.

.2 Equip with an audible alarm to signal and indicate when the barrier fence gate is in motion.

.3 Monitor passage by inductive loop detector, infrared beams, safety edge or other means of monitoring, to ensure safety while passing the barrier fence gate:

.1 During Gate Opening:

.1 Continue and complete opening movement when object is detected.

.2 During Gate Closing:

.1 Immediately stop and re-open when object is detected.

.3 Return to regular operation once object is cleared.

.4 Provide graphical sign at each direction of barrier fence gate to control traffic.

3 Execution

3.1 INSPECTION

.1 Examine the substrate and surface for barrier fence gate to be installed with conditions to allow proper installation of the product. These conditions include but not limited to the following:

.1 Level concrete pad for gate operator.

.2 Power supply and control wiring must respect the manufacturer's recommendations.

.2 Proceed installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Install barrier fence gate posts and operator components on a level concrete base as per the reviewed shop drawings.

.2 Install barrier fence gate in strict accordance with manufacturer's instructions.

.3 Install gate leveled and securely anchored.

.4 Adjust gate with smooth movement, perform operation with no defect or failure. Correct and fix defects with proper operation to City's satisfaction.

3.3 TRAINING AND MAINTENANCE

.1 Arrange manufacturer's trained installer to demonstrate to City's maintenance crew the proper operation and the necessary service requirements of the equipment, including exterior maintenance.

.2 Maintain the equipment according to the manufacturer's instructions.

3.4 CLEANING

.1 Clean barrier operator and area carefully after installation to remove excess caulk, dirt, and labels.

END OF SECTION

1 General

1.1 SUMMARY

.1 Supply and install chain link fencing, complete with swing gates, as indicated in this Section.

1.2 RELATED REQUIREMENTS

.1 Section 03 30 00 – Cast-in-Place Concrete

.2 Section 32 31 19 – Metal Fencing and Gates

.3 City of Winnipeg CW 3550 – Chain Link Fencing and Gates

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Manufacturer and tradesmen executing the work of this Section shall have had a minimum 5 years continuous Canadian experience in successful manufacture and installation of work of type and quality shown and specified. Submit proof of experience upon Contract Administrator's request.

.2 Erection of chain link fencing and gates shall be by workers especially trained and experienced in this type of work. Have a senior, qualified representative at the job site to direct the work of this Section at all times.

1.4 SUBMITTALS

.1 Submit submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings:

.1 Submit fully dimensional shop drawings to Contract Administrator showing construction, assembly, elevations, sections and interfacing with work of other Sections.

.2 No work of this Section shall be fabricated until shop drawings and all other related submittals, documentation, certifications and samples as required by this Section, have been reviewed by Contract Administrator.

.3 Details shall indicate metal thicknesses, fasteners and welds, all anchorage assemblies and components and erection details.

.3 Samples:

.1 Submit to Contract Administrator for approval, samples of materials and components to be used in the systems, prior to fabrication of work together with name of manufacturer and technical literature. Submit 12" x 12" samples of chain link fence fabric in colour as selected by the Contract Administrator.

2 Products

2.1 APPROVED MANUFACTURERS

.1 Subject to compliance with specifications, use products of one of the following:

.1 McGowan Fence and Supply Ltd., or;

.2 Lundy Fence, Division of IVACO Inc., or;

.3 Peel Fence Systems Inc., or;

.4 Approved equal.

2.2 MATERIALS

.1 Steel Pipe: Conforming to CAN/CGSB-138.2-M80.

.2 Fabric: No.9 gauge (0.148" nominal) ultra violet light resistant, P.V.C. coated, galvanized steel wire in 2" mesh, with both top and bottom selvages twisted and barbed, conforming to CAN/CGSB-138.1-M80.

.3 End, Corner, and Pull Posts: Galvanized steel, minimum sizes and weights as follows;

.1 Up to 6'-0" Fabric Height: 2.375" outside diameter pipe, 3.65 lbs/lin. ft.

.2 Over 6'-0" Fabric Height: 2.875" outside diameter pipe, 5.79 lbs/lin. ft.

.4 Line Posts: Galvanized steel, minimum sizes and weights as follows;

.1 Up to 6'-0" Fabric Height: 1.90" outside diameter pipe, 2.70 lbs/lin. ft.

.2 Over 6'-0" to 8'-0" Fabric Height: 2.375" outside diameter pipe, 3.65 lbs/lin. ft.

.3 Over 8'-0" Fabric Height: 2.875" outside diameter pipe, 5.79 lbs/lin. ft.

.5 Gate Posts: Galvanized steel, for single gate or double leaf gate as follows;

.1 Up to 6'-0" Fabric Height: 2.875" outside pipe diameter, 5.79 lbs/lin. ft.

.2 Over 6'-0" Fabric Height: 4" outside diameter pipe, 9.11 lbs/lin. ft.

.6 Top Rail and Intermediate Rails: Galvanized steel, manufacturer's longest lengths as follows:

.1 Typical: 1.66" outside diameter pipe, 2.27 lbs/lin. ft.

.2 Couplings: Expansion type, approximately 6" long.

.3 Attaching Devices: Means of attaching top rail securely to each gate, corner, pull, and end post.

.7 Sleeves: Galvanized steel pipe with inside diameter not less than 1/2" greater than outside diameter of pipe. Provide steel plate closure welded to bottom of sleeves of width and length not less than 1" greater than outside diameter of sleeve as follows;

.1 Up to 6'-0" Fabric Height: Provide sleeve not less than 12" long.

.2 Over 6'-0" Fabric Height: Provide sleeve not less than 24" long.

.8 Tension Wire: Minimum No.7 gauge galvanized steel, coated coil spring wire, located at bottom of fence fabric.

.9 Wire Ties: Minimum No.11 gauge galvanized steel.

.10 Post Brace Assembly: Manufacturer's standard adjustable brace at end posts and at both sides of corner and pull posts, with horizontal brace located at midheight of fabric. Use same materials as top rail for brace, and truss to line posts with 0.375" diameter rod and adjustable tightener.

.11 Post Tops: Galvanized steel, weather tight closure cap for tubular posts, one cap for each post. Furnish cap with openings to permit passage of top rail.

.12 Stretcher Bars: Galvanized steel, one piece lengths equal to full height of fabrics with minimum cross section of 3/16" x 3/4" inch. Provide one stretcher bar for each gate and end post, and two for each corner and pull post.

.13 Stretcher Bar Bands: Manufacturer's standard.

.14 Barbed Wire: 2.5mm wire, three strands, four point barbs at 150mm on centre, zinc coated steel.

.15 Gate Hardware:

.1 Swinging Gate Hardware:

.1 Hinges: Offset type hinges to permit 180E gate opening. Provide 1-1/2 pair of hinges for each gate leaf over 6'-0" height.

.2 Latches: Forked or plunger bar type to permit operation from both sides of gate, with padlock eye.

.2 Double Leaf Gate Hardware:

.1 As specified herein for swinging gate hardware and in addition provide "mushroom" type flush plate gate stops with anchors set in concrete to engage centre drops rod/plunger bar. Arrange stops for use with one padlock to lock both gate leaves.

.3 Sliding Gate Hardware:

.1 Manufacturer's standard heavy-duty track, ball bearing hanger sheaves, overhead framing and supports, guides, stays bracing and accessories as required.

.16 Gate Cross-Bracing: 3/8" diameter galvanized steel adjustable length truss rods.

2.3 SETTING GROUT

.1 Concrete: Minimum 20 MPa. Refer to Section 03 30 00 – Cast-in-Place Concrete.

.2 Grout: Premixed, factory packaged, nonstaining, noncorrosive grout. Refer to Section 03 30 00 – Cast-in-Place Concrete. Provide type especially formulated for exterior application.

2.4 FINISHES

.1 Galvanize as follows:

.1 Fabric: Not less than 1.2 oz zinc/sq ft.

.2 Framing: Not less than 1.8 oz zinc/sq ft.

.2 P.V.C. Coating:

.1 Ultra violet light resistant, polyvinyl chloride (PVC) coating shall be applied by field bed method to preheated substrate, to 10 to 14 mils dry film thickness (DFT) on pipe and 7 to 10 mils dry film thickness (DFT) on fence fabric.

.2 Clean and pretreat surfaces as required to thermally bond the P.V.C. coating to surfaces.

.3 Colour shall be selected later by Contract Administrator from manufacturer's full available colour range.

2.5 FABRICATION

.1 Fabricate swing gate perimeter frames of 1.90" outside diameter galvanized steel pipe. Provide horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware, and accessories. Gates shall conform to CAN/CGSB-138.4-M82. Space frame members maximum 8'-0" apart.

.2 Assemble gate frames rigidly by welding or with special fittings and rivets. Use same fabric as specified for fence. Install fabric with stretcher bars at vertical edges. Bars may also be used at top and bottom edges. Attach stretchers to frame at 12" O.C. Install diagonal cross-bracing on gates as required to ensure frame rigidity without sag or twist.

.3 Attach hardware to provide security against removal or breakage.

.4 Fabricate swing gates, double gates and sliding gates as indicated on drawings.

3 Execution

3.1 INSTALLATION

.1 Install chain link fencing in strict accordance with CAN/CGSB-138.3-M80 and as specified herein.

.2 Space line posts at 10'-0" O.C. maximum.

.3 Methods for Setting Posts:

.1 Grade-Set Posts: Drill holes for post with auger or hand excavate. Excavate each post hole to minimum 12" diameter, or not less than 4 times the post diameter. Excavate to 4" below bottom of post. Set bottoms of posts 6" below "frost line". Hold, brace posts plumb, level while placing, consolidating and finishing concrete.

.2 SleeveSet Posts In Concrete: Anchor posts in concrete by means of pipe sleeves preset and anchored into concrete. Insert posts into sleeves and fill annular space between post and sleeve solid with grout. Mix and place grout in accordance with manufacturer's written instructions.

.4 Intermediate Rails: Provide centre rails where indicated. Install in one piece between posts and flush with post on fabric side, using offset fittings where necessary.

.5 Brace Assemblies: Install braces so posts are plumb with rod in tension.

.6 Tension Wire: Install tension wires through post cap loops before stretching fabric and tie to each post cap with minimum No.6 gauge galvanized wire. Fasten fabric to tension wire using No.11 gauge galvanized steel hog rings at 24" O.C.

.7 Fabric: Leave approximately 2" between finish grade and bottom selvage. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so fabric remains in tension after pulling force is released.

.8 Stretcher Bars: To secure end, and pull posts, thread through or clamp to fabric 4" O.C. and secure to posts with metal bands spaced on 12" O.C.

.9 Tie Wires:

.1 Use Ushaped wire conforming with diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted two full turns. Bend wire ends to minimize hazards to persons or clothing.

.2 Tie fabric to line posts with wire ties spaced 12" O.C. Tie fabric to rails and braces with wire ties spaced 24" O.C. Manufacturer's standard procedure will be accepted if of equal strength and durability.

.10 Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

.11 Barbed Wire: Install 3 strands of barbed wire on arms, tensioned and secured. Slope extension arms for barb wire outward.

.12 Install swing gates, double gates and sliding gates plumb, level and secure for full openings, without interference. Set all ground set hardware in concrete for secure anchorage. Adjust and lubricate all gate hardware for smooth and efficient operation.

END OF SECTION

1 General

1.1 SUMMARY

.1 Supply and install 2.4m high ornamental security fencing, as indicated in this Section.

1.2 RELATED REQUIREMENTS

.1 Section 03 30 00 – Cast-In-Place Concrete

.2 City of Winnipeg CW 3550 – Chain Link Fencing and Gates

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Manufacturer and tradespersons executing the work of this Section shall have had a minimum five (5) years continuous Canadian experience in successful manufacture and installation of work of type and quality shown and specified. Submit proof of experience upon Contract Administrator's request.

.2 Erection of ornamental metal fencing shall be by workers especially trained and experienced in this type of work. Have a senior, qualified representative at the job site to always direct the work of this Section.

1.4 DESIGN REQUIREMENTS

.1 Design and engineer ornamental security fencing to withstand minimum 170 Kph wind load.

1.5 SUBMITTALS

.1 Shop Drawings:

.2 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit fully dimensional shop drawings to Contract Administrator showing construction, assembly, elevations, sections, and interfacing with other Work.

.2 No work of this Section shall be fabricated until shop drawings and all other related submittals, documentation, certifications, and samples as required by this Section, have been reviewed by Contract Administrator.

.3 Details shall indicate metal thicknesses, fasteners and welds, all anchorage assemblies and components and erection details.

.3 Samples:

.1 Submit to Contract Administrator for approval, samples of materials and components to be used in the systems, prior to fabrication of work together with name of manufacturer and technical literature.

.2 Colour sample chips from manufacturer shall be checked.

2 Products

2.1 APPROVED SYSTEMS AND MANUFACTURERS

.1 Ornamental security fencing shall be heights as indicated on drawings, complete with square posts, standard post caps, masonry attachment brackets and other brackets and stainless-steel tamper-proof anchors, 'OMEGA Secur Fence' by Omega II Fence.

2.2 MATERIALS

.1 Panel Height:

.1 2.4m high nominal panels

.2 Model “Secur” Fence and Accessories:

.1 2.5m wide, welded by one vertical wire of 4 gauge (5.7mm) placed between two horizontal wires of 7.7mm to form rectangles.

.2 Cold rolled annealed wire made of AISA Grade 1018 steel with tensile strength of at least 75,000 psi (515 Mpa) in accordance with ASTM A853.

.3 One end of the vertical wires of the panel shall extend 25.4mm from the last or the first horizontal wire to create a spiked top or bottom depending on installed position. The other end is cut flush.

.4 Panel camber may not exceed 2.5mm.

.3 Square Posts:

.1 Cold rolled 1008 grade steel to meet ASTM A500 and ASTM A787 and the following maximum horizontal loads, length as required for installation type:

.1 The length of the posts is minimum 914mm more than the actual height of the fence for installation in the ground to comply with local provincial and municipal construction regulations related to frost depth.

.4 Welding:

.1 Conforms to CSA W59-1989.

.5 Post and Masonry Attachment Brackets:

.1 Manufacturer's standard.

.6 Anchors and Fasteners:

.1 Stainless steel, tamper-proof expansion type anchors with expansion shields and stainless steel, tamper-proof fasteners.

.7 Polyester Powder Coating:

.1 Polyester powder coating to be minimum 4 mils applied by an electrostatic process. Coating shall cover all surfaces of the wire and post sections. Coating shall be capable of withstanding the following tests:

.1 Adhesion test as per ASTM D3359 – Method B.

.2 Shock resistance tests as per ASTM D2794.

.3 Salt spray testing with a minimum of 1000 hours without red rust appearance, as per ASTM B117.

.4 Humidity resistance in a weather meter chamber as per ASTM D2247.

.5 Exposure to ultraviolet light with exposure of 1000 hours using apparatus Type E and 63°C as per ASTM D1499.

.2 Polyester Surface Coating Colour:

.1 Standard Coating: Black, RAL 9004 (30% Gloss)

2.3 FABRICATION

.1 Fit and assemble work in shop.

.2 Workmanship shall be best grade of modern shop practice known to recognized manufacturers specializing in this work. Joints and intersecting members shall be accurately fitted, made in true planes with adequate fastening. Wherever possible fastenings shall be concealed.

.3 Isolate where necessary to prevent electrolysis between metal to metal or metal to masonry or concrete contact. Apply 2 coats of bituminous paint.

.4 Fabricate work square, plumb, straight, true, and accurately fitted. Provide adequate reinforcement and anchorage.

.5 Drilling shall be reamed and exposed edges left clean and smooth. Welds shall be ground smooth and flush with adjacent surfaces.

.6 Include anchors and fastenings necessary to anchor work of this Section.

2.4 FINISHES

.1 Polyester Powder Coating:

.1 Homogenous, free-flowing glycidol polyester powder coating, 2.0 to 4.0 mils dry film thickness (DFT), electrostatically applied by spray method, conforming to ASTM B117-90 and thermal fused to surfaces. Apply finish coating in shop paint booth smooth and even, free of drips, creep, and other imperfections.

.2 Colour shall be gloss black for all fence components.

3 Execution

3.1 CONDITION OF SURFACES

.1 Inspect surfaces over which the work of this Section is dependent for any irregularities detrimental to the application and performance of the work. Notify the Contract Administrator in writing of all conditions which are at variance with those in the contract documents and/or detrimental to the proper and timely installation of the work of this Section. The decision regarding corrective measures shall be obtained from the Contract Administrator prior to proceeding with the affected work.

.2 Commencement of installation implies acceptance of surfaces and conditions.

3.2 INSTALLATION

.1 Make thorough examination of drawings and details, determine the intent, extent, materials, conditions of interfacing with other work and be fully cognizant of requirements.

.2 Work under this Section shall include complete installation of items specified herein. Installation shall be in strict accordance with manufacturer's printed instructions.

.3 Securely fasten ornamental metal fencing level, plumb and secure in the locations shown on the drawings and specified herein.

.4 Methods for Setting Posts:

.1 Grade-Set Posts: Drill holes for post with auger or hand excavate. Excavate each post hole to minimum 300mm diameter. Excavate to 100 mm below bottom of post. Set bottoms of posts 150mm below "frost line". Hold, brace posts plumb, level while placing, consolidating, and finishing concrete.

.2 Core Set Posts In precast concrete retaining walls: Anchor posts in concrete or precast concrete retaining walls by means of coring into and thru the top 3 layers of precast concrete retaining walls and anchored into the walls with a non shrink epoxy. Mix and place grout in accordance with manufacturer's written instructions.

.5 Co-ordinate the work of this Section with the work of other Sections to provide the necessary conditions for the ornamental metal fencing and gates as required.

.6 Do all drilling of steel, masonry and concrete necessary for the anchorage of the work of this Section.

3.3 CLEANING

.1 Upon completion of the work of this Section, or when directed by the Contract Administrator, remove all protective coatings and coverings from ornamental metal fencing clean and polish all exposed surfaces.

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section specifies the supply and installation of exterior site furnishings.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM):

.1 ASTM B117-11, “Standard Practice for Operating Salt Spray (Fog) Apparatus”.

.2 ASTM D522-13, “Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings”.

.3 ASTM D523-14, “Standard Test Method for Specular Gloss”.

.4 ASTM D2247-11, “Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity”.

.5 ASTM D2794-93 (R2010), “Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)”.

.6 ASTM D3359-09, “Standard Test Methods for Measuring Adhesion by Tape Test”.

.7 ASTM D3363-05 (R2011), “Standard Test Method for Film Hardness by Pencil Test”.

.8 ASTM G155-13, “Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials”.

.2 International Organization for Standardization (ISO):

.1 ISO 1520:2006, Paints and Varnishes-Cupping Test.

.2 ISO 2815:2003, Paints and Varnishes-Buchholz Indentation Test.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for site furniture and include product characteristics, performance criteria, physical size, finish, and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit maintenance data for care and cleaning of site furnishings for incorporation into manual specified in Section 01 77 19 - Closeout Requirements.

.2 Manufacturer will confirm supply of spare parts for replacement purposes.

1.5 QUALITY ASSURANCE

.1 Sustainable Standards Certification:

.1 Sustainability Data sheet from manufacturer for each type of furnishing including but not limited to materials, recyclable content and finishes.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect furnishings from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: Remove for reuse of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Construction Waste Management.

1.7 WARRANTY

.1 Products will be free from defects in material and workmanship for a period of one (1) year from the date of invoice.

.2 The warranty does not apply to damage resulting from accident, alteration, misuse, tampering, negligence, or abuse.

.3 Site furnishing supplier shall repair, replace, or refund the purchase price of any items found defective upon inspection by an authorized supplier service representative.

.4 Purchasers should be aware that normal use of these high-quality products can result in superficial damage affecting the finish. Scratches, nicks, and dents are to be considered normal wear and tear and are not the responsibility of the manufacturer.

2 Products

2.1 FURNISHINGS

.1 Picnic Table:

.1 Landscape Forms Charlie Table, 67” table with umbrella hole. Colour: Blue Ash, supplied, assembled and installed by the Contractor.

.2 Landscape Forms Solstice Umbrella, Cygnus with perforated panels and surface mount stand. Colour: Panel- Blue Ash and pole - Fog, supplied, assembled and installed by the Contractor.

.2 Bicycle Rack: Landscape Forms LOOP bike rack. Colour: Gloss black, supplied, assembled and installed by the Contractor.

3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for exterior site furnishing installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied

3.2 PREPARATION

.1 Locate and protect utility lines.

.2 Notify and acquire written acknowledgment from utility authorities before beginning installation work

3.3 INSTALLATION

.1 Assemble furnishings in accordance with manufacturer's written recommendations.

.2 Install furnishing true, plumb, anchored firmly supported, as indicated, or directed by Contract Administrator.

.3 Touch-up damaged finishes to approval of Contract Administrator.

3.4 CLEANING

.1 Progress Cleaning:

.1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools, and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction Waste Management.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by site furnishings installation.

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section specifies requirements for topsoil testing, amending and placement of topsoil and grading work.

1.2 RELATED REQUIREMENTS

.1 N/A

1.3 REFERENCE STANDARDS

.1 Winnipeg Standard Construction Specifications:

.1 CW 3540, Topsoil and Finish Grading for Establishment of Turf Areas

.2 Agriculture and Agri-Food Canada:

.1 The Canadian System of Soil Classification, Third Edition, 1998.

.3 Canadian Council of Ministers of the Environment:

.1 PN1340-2005, Guidelines for Compost Quality.

.4 Canadian Nursery Landscape Association (CNLA):

.1 Canadian Standards for Nursery Stock, 8th Edition, 2006.

1.4 DEFINITIONS

.1 Compost:

.1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.

.2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.

.2 Product will be sufficiently decomposed (i.e. stable) so that further decomposition does not adversely affect plant growth (C:N ratio below 25) and contain no toxic or growth inhibiting contaminates.

1.5 SUBMITTALS

.1 Provide submittals in accordance with Construction Quality Management Plan.

.2 Quality control submittals:

.1 Certificates: Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 QUALITY ASSURANCE

.1 Pre-installation meetings: Conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.

2 Products

2.1 TOPSOIL

.1 Topsoil for seeded areas: mixture of particulates, micro-organisms and organic matter which provides suitable medium for supporting intended plant growth.

.2 Soil texture based on The Canadian System of Soil Classification, to consist of 20 to 70% sand, minimum 7% clay and contain 2 to 10% organic matter by weight.

.3 Contain no toxic elements or growth inhibiting materials.

.4 Finished surface free from:

.1 Debris and stones over 50 mm diameter; and

.2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.

.5 Consistence: Friable when moist.

2.2 SOIL AMENDMENTS

.1 Fertilizer:

.1 Fertility: Major soil nutrients present in following amounts:

.2 Nitrogen (N): Twenty (20) to forty (40) micrograms of available N per gram of topsoil.

.3 Phosphorus (P): forty (40) to fifty (50) micrograms of phosphate per gram of topsoil.

.4 Potassium (K): Seventy-five (75) to one-hundred-ten (110) micrograms of potassium per gram of topsoil.

.5 Calcium, magnesium, sulfur, and micro-nutrients present in balanced ratios to support germination/establishment of intended vegetation; and

.6 pH value: 6.0 to 8.0.

.7 Fertilizer: Industry accepted standard medium containing nitrogen, phosphorous, potassium and other micro-nutrients suitable to specific plant species or application or defined by soil test.

.2 Compost:

.1 Decomposing organic matter such as cow manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability, and contaminant requirements.

.2 Processed organic matter containing 40% (by dry weight) or more organic matter as determined by Walkley-Black or Loss on Ignition (LOI) test.

.3 Product will be sufficiently decomposed (i.e., stable) so that further decomposition does not adversely affect plant growth (C:N ratio below 25) and contain no toxic or growth inhibiting contaminates.

.4 Composted bio-solids to: CCME Guidelines for Compost Quality, Category A.

.3 Sand: Washed coarse silica sand, medium to course textured.

.4 Limestone:

.1 Ground agricultural limestone.

.2 Gradation requirements: Percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.

2.3 SOURCE QUALITY CONTROL

.1 Imported topsoil to comply with requirements of Section 2.1.

.2 Contractor is responsible for supplying and mixing the amendments to meet the requirements of 2.2 above and in accordance with recommendations from the Soil Tests.

.3 Topsoil Testing: Contractor shall test on-site or imported topsoil within thirty (30) working days of planting schedule. Testing of topsoil will be carried out by testing laboratory designated by Contractor. Topsoil testing will be the responsibility of the Contractor and will involve the following:

.4 Arrange for and be responsible for costs related to soil testing at a certified soil testing laboratory. Testing laboratory means a facility accredited by the Canadian Association for Environmental Analytical Laboratories (CAEAL)/Manitoba Department of Agriculture, Food and Rural Initiatives, to complete the tests as required by the submission requirements.

.5 Submit two (2) copies of soil analysis and recommendations to Contract administrator prior to importing or amending planting soil.

.6 Test for N (nitrogen), P (phosphorus), K (potassium), Mg (magnesium), soluble salt content, organic matter, soil sterilants, hydraulic conductivity, particle size distribution and pH;

.7 Laboratory will also provide a fertilizer recommendation that outlines the required improvements to produce an optimum growing environment for the establishment of “young nursery stock”.

.8 Submit laboratory soil analysis and soil amendment recommendations to Contract administrator for review before acting on the recommendations.

.9 Conform to soil amendment recommendations of the laboratory as approved by Contract administrator; and

.10 The Contractor will adjust specified fertilizer recommendations and rates, as well as addition of other additives and re-test the planting soil as required by Contract administrator at no additional cost to the City.

.11 Take soil samples prior to topsoil stripping from areas to be stripped and cleared if applicable. If topsoil is being provided by a topsoil supplier provide test results showing consistency with requirements in 2.1 and 2.2.

3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties, according to requirements of Authorities Having Jurisdiction.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 PREPARATION OF SUBGRADE

.1 Verify that grades are correct.

.1 If discrepancies occur, notify the Contract Administrator, and do not commence work until instructed.

.2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.

.3 Remove debris, roots, branches, stones more than 50 mm diameter and other deleterious materials.

.1 Remove soil contaminated with calcium chloride, toxic materials, and petroleum products.

.2 Remove debris which protrudes more than 75 mm above surface.

.3 Dispose of removed material off-site.

.4 Loosen areas which are to receive topsoil and sod to a minimum depth of 25 mm.

.1 Prepare these areas to provide a continuous loose subgrade layer. Do not place topsoil until the subgrade layer has been accepted by the Contract Administrator. Placing topsoil on a compacted subgrade will be rejected.

3.3 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

.1 Place topsoil after the Contract Administrator has accepted subgrade.

.2 Spread topsoil in uniform layers not exceeding 150 mm.

.3 Spread topsoil to the following minimum depths after settlement.

.1 150 mm deep for seeded areas

.2 450 mm deep of triple mix in a continuous layer for shrub/perennial/ornamental grass beds. This requirement supersedes other standard shrub planting details that may be shown in this Contract.

.3 900 mm deep for tree pits. Excavate and provide 2x the root ball diameter of topsoil per tree pit. This requirement supersedes other standard tree pit details that may be shown in this Contract.

.4 Manually spread topsoil around trees, shrubs, and obstacles.

.5 Contractor shall not place topsoil in wet muddy conditions or if frost or frozen conditions are present.

3.4 SOIL AMENDMENTS

.1 Thoroughly mix the recommended soil amendments, recommended in the Soil Testing Report into the full specified depth of the topsoil.

3.5 FINISH GRADING

.1 Grade to eliminate rough spots and low areas and ensure positive drainage.

.1 Prepare loose friable bed by means of cultivation and subsequent raking.

.2 Consolidate topsoil to required bulk density using equipment approved by the Contract Administrator.

.1 Leave surfaces smooth, uniform and firm against deep foot printing.

3.6 ACCEPTANCE

.1 The Contract Administrator will determine acceptance of material, depth of topsoil and finish grading based on testing results provided by the Contractor.

3.7 SURPLUS MATERIAL

.1 Dispose of materials legally off-site that are not required including excess topsoil.

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section specifies the requirements for hydraulic seeding.

1.2 RELATED REQUIREMENTS

.1 Section 32 91 19 – Topsoil Placement and Grading

.2 Section 32 93 10 – Landscape Maintenance

1.3 REFERENCE STANDARDS

.1 City of Winnipeg Standard Construction Specification CW 3520 – Seeding

.2 Canadian Nursery Landscape Association (CNLA):

.1 Canadian Standards for Nursery Stock, 8th Edition, 2006.

.3 Canadian Food Inspection Agency (CFIA):

.1 Seeds Act R.S.C., 1985, c.S-8

.4 Department of Justice Canada (Jus):

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.2 Fertilizers Act (R.S. 1985, c. F-10).

.3 Fertilizers Regulations (C.R.C., c. 666).

1.4 SUBMITTALS

.1 Product Data:

.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.

.2 Provide product data for annually/mechanically applied hydraulic seeding:

.1 Seed.

.2 Mulch.

.3 Tackifier.

.4 Fertilizer.

.5 Erosion Control Blanket.

.3 Submit in writing to Contract Administrator seven (7) days prior to commencing work:

.1 Volume capacity of hydraulic seeder in litres;

.2 Amount of material being used per tank based on volume; and

.3 Number of tank loads required per hectare to apply specified slurry mixture per hectare.

1.5 QUALITY ASSURANCE

.1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.1 Seed supplied either as a single seed species or as a seed mix will comply with the provisions of the Canada Seed Act or the United States Department of Agriculture equivalent and the grade standards for the specific seed species.

.3 Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.

.4 Seed packaging, labelling and storage will be in accordance with CW 3520.

1.6 SCHEDULING

.1 Schedule hydraulic and direct seeding to coincide with preparation of soil surface.

.2 For optimum conditions, schedule hydraulic seeding from May 1 to June 15 or August 15 to October 15.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Divert unused fertilizer from landfill to official hazardous material collections site.

.3 Do not dispose of unused fertilizer into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

2 Products

2.1 MATERIALS

.1 Seed: “Canada pedigreed grade” in accordance with Government of Canada Seeds Act and Regulations.

.2 Seed Mixes:

.1 Native Prairie Meadow Seed Mix (OSC 8135)

.2 Native Slope Hillside Seed Mix (OSC 8225)

.3 SWM Pond Mix Drainage Channel Seed Mix (OSC 8173)

.4 SWM Pond Mix Wet/Dry Seed Mix (OSC 8245)

.3 Nurse Crop: Annual Oats (Avena sativa) or Canada Wild Rye (Elymus canadensis)

.4 Mulch: Specially manufactured for use in hydraulic seeding equipment, non-toxic, water activated, green colouring, free of germination and growth inhibiting factors with the following properties:

.1 Type I mulch:

.1 Made from wood cellulose fibre.

.2 Organic matter content: 95% ± 0.5%.

.3 Value of pH: 6.0.

.4 Minimum potential water absorption: 900%.

.5 Tackifier: Water dilutable, liquid dispersion.

.6 Water: Free of impurities that would inhibit germination and growth.

.7 Fertilizer:

.1 To Canada “Fertilizers Act” and “Fertilizers Regulations”.

.2 Complete synthetic, slow release with 35% of nitrogen content in water-insoluble form.

.8 Erosion Control Blankets:

.1 Reference Part E – Specifications, clause E14 and E15.

3 Execution

3.1 WORKMANSHIP

.1 Do **not** spray onto structures, signs, guide rails, fences, plant material, utilities and other than surfaces intended.

.1 Spraying cannon style from the back of a hydraulic seeding truck onto flat and sloped surfaces with planting compete will not be acceptable. Ground applied hydraulic seeding will be necessary to obtain proper coverage and not have overspray on installed

.2 Clean-up immediately, material sprayed where not intended.

.3 Do not perform work under adverse field conditions such as high winds, frozen ground or ground covered with snow, ice or standing water.

.4 Protect seeded areas from trespass until plants are established.

.5 Seed Mixes will be applied in the locations identified on Contract Drawings.

.6 Seed slopes with hydraulic seeding method.

3.2 PREPARATION OF SURFACES

.1 Fine grade areas being seeded free of humps and hollows. Ensure areas are free of deleterious and refuse materials.

.2 Cultivated areas identified as requiring cultivation to depth of 25 mm.

.3 Ensure areas being seeded are moist to depth of 150 mm before seeding.

.4 Obtain Contract Administrator approval of grade and topsoil depth before starting to seed.

.5 Placement of topsoil to comply with Section 32 91 19 Topsoil Placement and Grading.

3.3 FERTILIZING PROGRAM

.1 Supply and install 12-3-18 fertilizer at 3.1 kg's (7 lbs) and KMag 0-0-22 at .90 kg's per 92.90 m2 (1000 sq. ft.) in accordance with Topsoil Test Report. Contractor to submit the application approach two (2) weeks in advance of application for review and approval by Contract Administrator.

3.4 PREPARATION OF SLURRY

.1 Measure quantities of materials by weight or weight-calibrated volume measurement. Supply equipment required for this work.

.2 Charge required water into seeder. Add material into hydraulic seeder under agitation. Pulverize mulch and charge slowly into seeder.

.3 After materials are in the seeder and well mixed, charge tackifier into seeder and mix thoroughly to complete slurry.

3.5 SLURRY APPLICATION

.1 Hydraulic seeding equipment:

.1 Slurry tank.

.2 Agitation system for slurry being capable of operating during charging of tank and during seeding, consisting of recirculation of slurry/mechanical agitation method.

.3 Capable of seeding by 50 m hand operated hoses and appropriate nozzles.

.4 Tank volume being certified by certifying authority and identified by authorities "Volume Certification Plate".

.2 Slurry mixture applied per hectare.

.1 Seed: Grass mixture 26 kg.

.2 Mulch: Type I, 1,250 kg.

.3 Tackifier: 20 kg.

.4 Water: Minimum 30,000 L.

.5 Fertilizer: As noted in 3.3 above.

.3 Apply slurry uniformly, at optimum angle of application for adherence to surfaces and germination of seed.

.1 Using correct nozzle for application.

.2 Using hoses for surfaces difficult to reach and to control application.

.4 Blend application 300 mm into adjacent grass areas, sodded areas and previous applications to form uniform surfaces.

.5 Re-apply where application is not uniform.

.6 Remove slurry from items and areas not designated for spraying.

.7 Protect seeded areas from trespass.

.8 Remove protection devices as directed by Contract Administrator.

3.6 MAINTENANCE DURING ESTABLISHMENT PERIOD

.1 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.

.2 Fertilize seeded areas ten (10) weeks after germination provided plants have mature true leaves in accordance with fertilizing program. Spread half of required amount of fertilizer in one (1) direction and remainder at right angles.

.3 Control weeds by mechanical or chemical means utilizing acceptable integrated pest management practices.

3.7 ACCEPTANCE

.1 Seeded areas will be accepted by Contract Administrator provided that:

.1 Plants are uniformly established and seeded areas are free of rutted, eroded, bare or dead spots; and

.2 Areas have been fertilized.

.2 Areas seeded in fall will achieve final acceptance in following spring, one (1) month after start of growing season provided acceptance conditions are fulfilled.

.1 Seed review inspection shall follow a 30-, 60- and 90-day growing period after seeding.

3.8 MAINTENANCE DURING WARRANTY PERIOD

.1 Perform following operations from time of acceptance until end of warranty period:

.1 Repair and reseed dead or bare spots to satisfaction of Contract Administrator; and

.2 Fertilize seeded areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one (1) direction and remainder at right angles.

3.9 PAYMENT

.1 Include the cost of furnishing all labour, materials, tools, equipment, and incidentals necessary to supply and hydraulic seed, as shown on drawings and as specified in Section 32 92 19 – Hydraulic Seeding.

.2 Measurement to be made in square metre.

.3 Payment will be based on the area of completed work item.

.4 Notwithstanding supplemental conditions clause D30, Payment;

.1 Sixty-five (65%) percent of quantity following supply and placement

.2 Remaining thirty-five (35%) percent of quantity following termination of the maintenance period.

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section specifies sodding requirements for landscaping work.

1.2 RELATED SECTIONS

.1 Section 32 91 19 – Topsoil Placement and Grading

1.3 REFERENCES

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-32.310-2006, Organic Production Systems-General Principles and Management Standards.

.2 CAN/CGSB-32.311-2006, Permitted Substances Lists.

.2 Canadian Food Inspection Agency (CFIA):

.1 Canada Agricultural Products Act, P.C. 2009-944 June 11, 2009, Organic Products Regulations, 2009.

.2 Fertilizers Act (R.S.C. 1985, c. F-10).

.3 Trade memoranda, T-4-106, Organic Fertilizers Under the Fertilizers Act.

.3 Canadian Nursery Landscape Association (CNLA):

.1 Canadian Standards for Nursery Stock, 8th Edition.

.4 City of Winnipeg Standard Construction Specification CW 3510 – Sodding

1.4 SUBMITTALS

.1 Submit seed species and percentages that make up sod for each type specified.

.2 Install approved samples in 1 m^2 mock-ups and maintain in accordance with maintenance requirements during establishment period.

.3 Obtain approval of installed samples by Contract Administrator.

.4 Product data in printed literature for fertilizer.

1.5 QUALITY ASSURANCE

.1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.

1.6 SCHEDULING

.1 Schedule sod laying to coincide with preparation of soil surface.

.2 Schedule sod installation when frost is not present in ground.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with 01 74 19 Construction Waste Management.

.2 Divert unused fertilizer from landfill to official hazardous material collections site.

.3 Do not dispose of unused fertilizer into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

2 Products

2.1 MATERIALS

.1 Number One Turf Grass Nursery Sod: Sod that has been especially sown and cultivated in nursery fields as turf grass crop.

.1 Turf Grass Nursery Sod types:

.1 Number One Kentucky Bluegrass Sod and/or Fescue Sod: Nursery Sod grown solely from seed mixture of cultivars of Kentucky Bluegrass and/or Chewing Fescue or Creeping Red Fescue, containing not less than 40% Kentucky Bluegrass cultivars and 30% Chewing Fescue or Creeping Red Fescue cultivars.

.2 Turf Grass Nursery Sod quality:

.1 Not more than two (2) broadleaf weeds or ten (10) other weeds per 40 m^2.

.2 Density of sod sufficient so that no soil is visible from height of 1,500 mm when mown to height of 50 mm.

.3 Mowing height limit: 35 to 65 mm.

.4 Soil portion of sod: 6 mm to 15 mm in thickness.

.2 Sod establishment support:

.1 Biodegradable starch pegs: 17 mm x 8 mm x 200 mm.

.3 Water:

.1 Supplied from an off-site source by the Contractor.

.2 Free of impurities that would inhibit germination and growth.

.4 Fertilizer:

.1 To Canada “Fertilizers Act” and “Fertilizers Regulations”.

.2 Complete, synthetic, slow release with 65% of nitrogen content in water-insoluble form.

2.2 SOURCE QUALITY CONTROL

.1 Obtain approval from Contract Administrator of sod at source.

.2 When proposed source of sod is approved, use no other source without written authorization from Contract Administrator.

3 Execution

3.1 PREPARATION

.1 Verify that grades are correct and prepared in accordance with Section 32 91 19 - Topsoil Placement and Grading. If discrepancies occur, notify Contract Administrator, and do not commence work until instructed by Contract Administrator.

.2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice or standing water.

.3 Fine grade surface free of humps and hollows to smooth, even grade, to contours and elevations indicated, to tolerance of 15 mm +/-, for Turf Grass Nursery Sod, surface to drain naturally.

.4 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline, and other deleterious materials; off-site.

3.2 SOD PLACEMENT

.1 Lay sod within twenty-four (24) hours of being lifted if air temperature exceeds 20°C.

.2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.

.3 Roll sod as directed by Contract Administrator. Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

3.3 FERTILIZING PROGRAM

.1 Fertilize during establishment and warranty periods to following program:

.1 Supply and install fertilizer during the spring, summer and fall seasons as recommended by the soil test. Fertilizer type, rate and ratio in accordance with the recommendations in the soil test.

3.4 MAINTENANCE DURING ESTABLISHMENT PERIOD

.1 Perform following operations from time of installation until acceptance:

.1 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 mm to 100 mm.

.2 Cut grass to 50 mm when or prior to it reaching height of 75 mm. Remove clippings which will smother grassed areas.

.3 Maintain sodded areas weed free 95%; and

.4 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.

3.5 ACCEPTANCE

.1 Turf Grass Nursery Sod areas will be accepted by Contract Administrator provided that:

.1 Sodded areas are properly established.

.2 Sod is free of bare and dead spots.

.3 No surface soil is visible from height of 1,500 mm when grass has been cut to height of 50 mm; and

.4 Sodded areas have been cut minimum three (3) times prior to acceptance.

.2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

3.6 MAINTENANCE DURING WARRANTY PERIOD

.1 Perform following operations from time of acceptance until end of warranty period:

.1 Water sodded areas at weekly intervals to obtain optimum soil moisture conditions to depth of 100 mm.

.2 Repair and resod dead or bare spots to satisfaction of the Contract Administrator; and

.3 Cut grass and remove clippings to height as follows:

.1 Turf Grass Nursery Sod:

.1 50 mm during normal growing conditions.

.2 Commercial Grade Turf Grass Nursery Sod:

.1 60 mm during normal growing conditions.

.3 Cut grass at one (1) week intervals but at intervals so that approximately one third of growth is removed in single cut.

.4 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well: and

.5 Eliminate weeds by mechanical or chemical means.

3.7 PAYMENT

.1 Include the cost of furnishing all labour, materials, tools, equipment, and incidentals necessary to supply and sod, as shown on drawings and as specified in Section 32 92 23 - Sodding.

.2 Measurement to be made in square metre.

.3 Payment will be based on the area of completed work item.

.4 Notwithstanding supplemental conditions clause D30, Payment;

.1 Sixty-five (65%) percent of quantity following supply and placement.

.2 Remaining thirty-five (35%) percent of quantity following termination of the maintenance period.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 32 92 19 – Hydraulic Seeding

.2 Section 32 92 23 - Sodding

.3 Section 32 93 53 - Planting of Trees, Shrubs and Ground Cover

.4 City of Winnipeg Standard Specification CW 3520 – Seeding and Maintenance

1.2 GENERAL

.1 Work Included: To carry out maintenance of seeded areas and plant material for the duration of the warranty period that extends one (1) year from the date of Substantial Performance of the Work. Refer to Section 32 93 53 – Planting of Trees, Shrubs and Ground Covers.

.1 Ensure health and vigor of seed

.2 Ensure health and vigor of trees, shrubs, and ground covers

.2 Default

.1 In the event that the landscape maintenance Contractor fails to respond to maintenance and warranty requests within 14 days from the Contract Administrator's written notification, the defective work of this section shall be rectified by another landscape sub-Contractor at the original awarded landscape sub-Contractor's expense.

1.3 QUALIFICATION OF LANDSCAPE MAINTENANCE CONTRACTOR

.1 Maintenance work will be done by experienced, qualified personnel with at least five years of horticultural and planting experience.

1.4 MAINTENANCE INSPECTIONS AND REPORTING PROCEDURES

.1 The Work of this Section will be inspected by the Contract Administrator on the anniversary of the first year of the maintenance period. A maintenance report will be provided to the landscape maintenance Contractor based on findings of inspection.

.2 Report in writing to the Contract Administrator the maintenance Work performed and a schedule of Work to be performed on a seasonal basis: Spring Report by May 1, Summer Report by September 1, and a Fall Report by November 1. Immediately report damages resulting from vandalism or other causes beyond the landscape sub-Contractor's control to the Contract Administrator.

.3 Make periodic inspections of plants, sodded and seeded areas during the maintenance period and notify the Contract Administrator in writing of preventative or corrective measures necessary to maintain the plants and seeded areas in good, healthy condition. Inspection of the Site will be carried out by the landscape maintenance Contractor on a bi-weekly basis. Inspections will focus on assessment of plant vigour, grass density, weed growth to establish corrective measures, and other Site-specific observations related to plant health.

.4 Coordinate all Work with the Contract Administrator to ensure that there is no interference with the operation and maintenance of the Site.

2 Products

Not Used

3 Execution

3.1 MAINTENANCE OF TREES, SHRUBS, GROUND COVERS, SODDED AND SEEDED AREAS

.1 Include in the Work of this Section maintenance to ensure vigorous and healthy growth. Maintenance will consist of, but not be limited to, the following: pruning; cultivating; monthly weeding; fertilizing; mulching; watering; repair of trunk protection; securing of tree stakes; tightening of wires; resetting to proper grade or upright position; spraying to keep free of pests, insects and disease; and barriers to prevent damage by persons or animals. Thoroughly water evergreens in late fall prior to freeze-up to saturate soil around root system. Reform damaged watering saucers.

.2 Remove unwanted vegetation from mulched planting beds during the maintenance period.

3.2 ADJUSTMENT AND REPLACEMENT

.1 Perform adjustment and replacement Work with materials of the same type and quality as outlined in the Contract Drawings and Section 32 93 53 – Planting of Trees, Shrubs and Ground Covers. Replacement Work will have a warranty of the same length and with the same conditions as outlined in Section 32 93 53 – Planting of Trees, Shrubs and Ground Covers. The landscape maintenance Contractor shall provide a renewed warranty that starts from time of approval of the replacement work of this section.

.2 Replace plant stock that is dead, or not in a flourishing growing state, or does not meet the requirements set out in the Specifications. Remove dead stock immediately. Replace stock at the proper time during the next planting season. Tag or mark replacement material in a permanently visible manner and notify the Contract Administrator in writing of the date on which the replacement was planted. Include a sketch showing the location of replaced plants.

.3 After settlement has occurred at the planting pits, fill in to the specified grade with planting soil mixture.

3.3 WEED CONTROL

.1 Tree Pits, Planting Beds and seeded areas: Remove weeds from planting berm/saucer and planting bed mulch on a regular basis. Top up mulch to ensure 75 mm depth during the maintenance period.

.2 Application of herbicide to control grass growth around trees and planting beds shall be coordinated with a licensed herbicidal applicator. Any application of herbicide shall be confirmed with Contract Administrator prior to being carried out.

.3 Remove stakes and guys at the end of the maintenance period.

3.4 FERTILIZING

.1 Fertilize plant material as necessary to maintain plants in a healthy vigorous growing condition.

3.5 WATERING

.1 Water all plant material every 3 weeks for the period between mid-May and mid-August, five (5) times per season for the first two growing seasons for a total of ten (10) waterings.

.2 Provide additional watering if required to keep plants well-watered to ensure vigorous, healthy growth.

.3 Water seeded areas if seeded in the spring (or early summer) regularly during the first 6-8 weeks after planting, to maintain optimum soil moisture level for germination and continued growth of grass. Control watering to prevent incidents of erosion. OBJ

3.6 MOWING SEEDED AND SODDED AREAS

.1 Mow sodded areas weekly and maintain a height of 5 cm. Remove clippings and cut vegetation which will smother grass. If necessary, mow twice per week with frequency dependent on rainfall, weed density and height.

.2 Mow seeded areas twice per growing season. Once in mid May and once in late September to a height of 150mm.

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section specifies planting requirements for trees, shrubs, perennials, and ground cover.

1.2 RELATED SECTIONS

.1 Section 32 93 10 - Landscape Maintenance

1.3 QUALIFICATIONS OF CONTRACTOR

.1 Experienced, qualified personnel under the direction and supervision of a foreman with at least five (5) years of horticultural and planting experience will carry out planting and related work.

.2 The work of this Section will be carried out while the Contract Administrator is on site and directly supervising the planting operation.

1.4 REFERENCES

.1 The City of Winnipeg – Tree Planting and Maintenance Specifcation.

.2 Manitoba Agriculture, Food and Rural Initiatives.

.3 Canadian Association for Environmental Analytical Laboratories (CAEAL).

.4 Canadian Nursery Trades Association: Canadian Standards for Nursery Stock, Latest Edition.

.5 American Association of Nurserymen (AAN): Z60.1, Nursery Stock.

.6 Hortus Third, Liberty Hyde Bailey, Hortorium.

.7 Agriculture Canada Publication 1507, The Pruning Manual.

1.5 DEFINITIONS

.1 Measurement:

.1 In size grading Balled and Burlapped (B&B) and wire basket (W.B.) trees, caliper takes precedence over height.

.2 Take trunk caliper 150 mm above the ground level (up to and including 100 mm caliper size) and 300 mm above the ground level for larger diameter trees.

.3 Measure size of container-grown stock by height and width of plant.

.4 Measure herbaceous stock by pot size, not top growth.

1.6 SUBMITTALS

.1 Information Submittals:

.1 The Contractor will provide source and availability of plant material specified on the Plant List(s) to Contract Administrator four (4) weeks prior to commencing the Work.

.2 The Contractor will provide a detailed planting schedule for plant material specified on the Plant List(s) to Contract Administrator four (4) weeks prior to commencing the Work.

.3 Product labels/data sheets on manufactured products specified.

.4 Description of required maintenance activities and activity frequency.

.5 Description of watering program context and frequency to maintain required moisture conditions for optimum growth.

.6 Topsoil test results and fertilizer recommendations for planting soil.

.2 Product Samples: Submit two (2) samples of plant bed mulch, trunk protection devices and accessories for tree-staking/guying for approval prior to initiating planting.

.1 Retain approved samples on Site in a readily available location.

.2 Products used will conform to approved samples.

.3 Topsoil Testing: Test on-site topsoil within thirty (30) working days of planting schedule. Topsoil testing will be the responsibility of the Contractor and will involve the following:

.1 Arrange for and be responsible for costs related to soil testing at a certified soil testing laboratory. Testing laboratory means a facility accredited by the Canadian Association for Environmental Analytical Laboratories (CAEAL)/Manitoba Agriculture, Food and Rural Initiatives, to complete the tests as required by the submission requirements.

.2 Submit two (2) copies of soil analysis and recommendations to Contract Administrator prior to importing or amending planting soil.

.3 Test for N (nitrogen), P (phosphorus), K (potassium), Mg (magnesium), soluble salt content, organic matter, soil sterilants, hydraulic conductivity, particle size distribution and pH;

.4 Laboratory will also provide a fertilizer recommendation that outlines the required improvements to produce an optimum growing environment for the establishment of "young nursery stock".

.5 Submit laboratory soil analysis and soil amendment recommendations to Contract Administrator for review before acting on the recommendations.

.6 Conform to soil amendment recommendations of the laboratory as approved by Contract Administrator; and

.7 The Contractor will adjust specified fertilizer recommendations and rates, as well as addition of other additives and re-test the planting soil as required by Contract Administrator at no additional cost to Contract Administrator.

.4 Planting Soil Mixture Testing: Utilize approved topsoil and amend as required to produce planting soil mixture. Carry out planting soil analysis as defined above and provide fertilizer recommendations for "young nursery stock".

1.7 SOURCE, DELIVERY, STORAGE AND HANDLING

.1 The Contractor will arrange for inspection of plant material outlined in the Plant List(s) at its source with the Department Representative. Acceptance of the plant material at its source does not prevent rejection of the plant material upon delivery to the site or during the planting operation.

.2 Delivery of plant material will be coordinated with planting operations to ensure minimum time lapse between digging and replanting of the plant material.

.3 All plant material supplied and planted under this Contract will be protected from damage in accordance with OPSS 801, during construction operations. Plant material damaged by the Contractor's operations will be replaced at Contractor's own expense.

.4 All plant material will be inspected upon delivery to the site prior to unloading. A copy of the delivery receipt will be provided at the time of delivery. Off spec material will be removed from site immediately and replacements shipped to the site within two (2) Working Days.

.5 Plant material will be inspected again prior to planting. Off spec material will be removed from the site immediately and replacements shipped to the site within two (2) Working Days.

.6 Plant Material:

.1 Plants will be contained as specified in the Plant List(s) and meet the minimum height and caliper dimension requirements.

.2 Plants will carry a tag from the nursery identifying the nursery, botanical description, container size and plant height/spread/caliper.

.3 Transport plants specified as Balled & Burlapped/Wire Basket with solid root balls wrapped with 150-gram Hessian burlap. Securely bind burlapped rootballs with twine, natural fibre cord, or wire for shipment and handling. Drum-lace balls with a diameter of 800 mm or more.

.4 Transport plants with branches tied to prevent damage and pad trunks to avoid abrasion from equipment during transport. Avoid binding of plant material with rope or wire that would damage bark, break branches, or destroy the natural shape of the plant.

.5 Transport plants in enclosed vehicles or covered by tarps. Do not permit plants that will be desiccated by wind. Plants arriving on site in unprotected transport will not be accepted.

.6 Prevent drying out of roots, root balls, trunks, branches and leaves of plants from the time of removal at place of origin until they are planted.

.7 All deciduous trees that have budded out and coniferous trees will be thoroughly sprayed with an anti-desiccant immediately before transport to the site. Apply enough over trunks, branches, and foliage. Plants may be re-sprayed after delivery to the site and once planted if deemed necessary by Contract Administrator.

.8 Balled and burlapped, wire basket and container grown plant material will not be stored on the site unless the root ball or container is protected from the sun and wind and kept moist.

.9 While temporarily stored at the site, plant material will be placed in the shade where possible and soil, dampened straw or similar material will be placed around the root ball and keep moist at times.

.10 Plants with broken or abraded trunks or branches, or with broken cracked root balls, or plants that are desiccated, will be rejected upon arrival at the site.

.11 Plant material deemed unacceptable will immediately be removed from the site by the Contractor.

.7 Deliver planting materials in standard containers. Containers will be marked identifying contents of container, weight, analysis, and name of manufacturer.

.8 Store and protect fertilizer, bone meal, lime, mulch, and similar products to prevent damage from moisture.

1.8 WARRANTY

.1 The warranty will provide for removal and replacement with new plants, those transplanted, or newly planted plants found defective or will be dead or not in a vigorous, thriving condition during a period of one (1) year after the date of Substantial Performance of the Work. The Contractor's duties and obligations for correction or removal and replacement of defective work will be in accordance with the requirements specified in the General Conditions.

.2 Replace defective plants with new plants free of dead or dying branches and branch tips and bearing foliage of a normal density, size, and colour. Closely match new plants to adjacent specimens of the same species and meet the requirements of this Specification.

.3 Plant replacement plants, for those plants that die during a season unfavorable for planting, during the first month of the next favorable planting season.

.4 Plants damaged or lost due to vandalism or acts of neglect by others are not subject to this warranty, but during the period of one (1) year after the Date of Substantial Performance of the Work, the cost to replace defective plants is set as the initial tender price.

.5 The warranty period for replacement plants will be the same as the warranty period applied to the original plants and will extend from the date of acceptance of the replacement.

.6 Final inspection of plant material will be carried out by Contract Administrator at the end of the warranty period. At this time, plants will be in healthy, vigorous growing condition. The Contract Administrator reserves the right to extend the contractors warranty responsibilities for an additional year if at the end of the initial warranty period leaf development and growth is not sufficient to ensure future survival as determined by the Contract Administrator.

1.9 MAINTENANCE

.1 Commence to maintain plant material immediately after planting and maintain plant material in a vigorous growing condition throughout the warranty period.

.2 Maintenance Period: Begin maintenance immediately after planting and continue for 1 year after the date of Substantial Performance.

.3 In accordance with the accepted submittal on the care and maintenance of plants and as follows:

.1 Maintain by watering, pruning, cultivating, and weeding as required for healthy growth. Restore planting saucers.

.2 Tighten and repair stake and guy support and reset trees and shrubs to proper grades or vertical position as required.

.3 Install and maintain integrity of rodent protection measures (tree guards).

.4 Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.

.5 Remove stakes and other supports at the end of maintenance period.

.6 Maintenance includes temporary protection fences, barriers and signs as required for protection.

.7 Coordinate watering to provide deep root watering to newly installed trees.

.8 Install winter protection (burlap) to coniferous trees and remove the following spring during the maintenance period.

1.10 SCHEDULING AND SEQUENCING

.1 The Contractor will provide to Contract Administrator a detailed schedule outlining the proposed planting sequence.

.2 Plant Deliveries: Give written notice to Contract Administrator at least five (5) working days in advance of each delivery date.

.3 Planting Season: Conduct planting during times of the year that are normal for such work as determined by accepted local practice.

.1 Installation of B&B/W.B. and container grown plant material will be carried out from **May 1 – June 15 (Spring Planting) and from August 15 – September 30 (Fall Planting).**

.2 No planting shall occur when the ground is frozen or overly saturated.

.3 Planting may be delayed or suspended during periods of extreme heat or drought, at the discretion of the Contract Administrator.

.4 Plant trees and shrubs after the installation of hard structures and surfaces and upon the establishment of final grades. Planting work will be completed prior to initiating seeding work. Plant materials will be installed within a period that will allow for seeding or mulch applications.

.5 The location of plant material will be staked out on the ground for review by Contract Administrator. Excavation will commence following Contract Administrator inspection and approval of staking.

1.11 ENVIRONMENTAL REQUIREMENTS

.1 Execute work of this Section under suitable weather conditions and in a suitable growth season for each specified material and as approved by Contract Administrator.

2 Products

2.1 PLANT MATERIAL

.1 All plant material will be nursery grown and meet the specifications as set out in the latest Guide Specifications for Nursery Stock prepared by the Canadian Nursery Trades Association (CNTA) for size, height, spread, grading quality and method of cultivation.

.2 All plant material will be supplied from nurseries situated no more than one (1) hardiness zone difference from the site's hardiness zone.

.3 Nomenclature (Names of Plants): In accordance with "Hortus Third" and conforming to the International Code of Nomenclature of Cultivated Plants and the latest edition of Standardized Plant Names.

.4 Plants: No.1 grade, nursery-grown in fertile soil, with ample spacing, regular cultivation, weed and pest control, required moisture and pruning.

.5 Balled and burlapped, wire basket and container grown plant material will be dug and potted in accordance with the latest edition of the Guide Specification for Nursery Stock, prepared by the Canadian Nursery Trades Association/Landscape Canada.

.6 Plant List(s): Plant lists are outlined on Contract Drawings.

.7 Provide the quantity, size, genus, species and variety of trees, shrubs, ground covers and seedlings indicated on the contract drawings.

.8 Quality and Size:

.1 Nursery-grown, habit of growth normal for species, sound, healthy, vigorous, free from insects and injuries, well-branched and densely foliated when in leaf.

.2 Plant material will not be collected or dug from native stands or an established woodlot.

.3 Plants will be free of disease and insect pests, eggs, or larvae.

.4 Tree and shrub plants will possess characteristics of the specified kind, with leaders intact, undamaged, and uncut, growing from an unmutilated root system. Stems will be free from sun scalds, frost cracks, rodent damage, abrasions, fire, and crust. Old injuries will be completely callused over. Pruning wounds will show vigorous bark on edges and parts show live green cambium tissue when cut.

.5 Plant material sizes will be acceptable up to 40% above the measurements specified in the Plant List(s). Measure plants before pruning with branches in their normal position.

.6 Plant material will not be cut back from larger sizes to meet the specified Plant List(s) requirements.

.7 Balled and Burlapped Plants: Firm, intact ball of earth encompassing enough of the fibrous and feeding root system to enable full plant recovery.

.1 Burlap, rope, and tie material will be manufactured from natural organic fibers.

.8 Wire Basket Plants: Plants dug mechanically, intact soil ball of earth placed in a burlap lined wire basket, cross-laced wire basket, situate trunk in centre of basket.

.9 Container-Grown Plants: Self-established root systems, sufficient to hold earth together after removal from container, without being root bound.

.1 Stock: Grown in delivery containers for at least six (6) months but not over two (2) years.

.2 Well-developed and well distributed root system throughout the container, such that the roots visibly extend to the inside face of the growing container.

.9 Label each tree, shrub, ground cover and seedling specimen with a securely attached waterproof tag bearing a legible designation of botanical and common name.

.10 Replacement trees, shrubs, ground covers and other plant material shall be the same species, size and quality as specified for the plant being replaced.

.11 Substitutions: Substitutions to the plant list(s) will not be permitted unless prior written approval for a substitution from Contract Administrator has been obtained. Plant substitutions will be of a similar species and of equal or greater size than those originally specified. No additional cost will be entertained for substituted plant material.

2.2 TOPSOIL

.1 Imported topsoil will be used in the restoration planting and seeding areas.

.2 Topsoil will be capable of sustaining vigorous plant growth and be free of the following:

.1 Admixture of subsoil, lumps, and stones greater than 10 mm in diameter.

.2 Coarse vegetative material greater than 10 mm in diameter and 100 mm in length.

.3 Weeds, weed seeds and rhizomes; and

.4 Toxic material and soil sterilant that will inhibit plant development.

2.3 PLANTING SOIL MIX

.1 Planting Soil Mixture for trees, shrubs, shrub beds and large multi-stem trees.

.1 Premixed 80% sandy loam topsoil and 20% compost and well-rotted sheep's or cow manure.

.2 Do not mix when topsoil is in a muddy or frozen condition.

2.4 ANTI-DESICCANT

.1 Anti-desiccant emulsion will be a product specifically manufactured to provide a flexible surface film to reduce transpiration yet not impede passage of carbon dioxide and oxygen

.2 Emulsion to form a permeable film over plant surfaces and mixed according to the manufacturer's instruction.

.3 Transpiration retarding material will be used where plant material is moved during the growing season.

2.5 STAKING

.1 For deciduous trees:

.1 Heartwood: 38 mm by 38 mm by 1.8 metres.

.2 Tree Ties: Green arbortie or approved equivalent.

2.6 TRUNK PROTECTION

.1 Plastic: 100 mm dia. white corrugated PVC pipe 550 mm high. Protect against rodent damage.

.2 Plastic Rodent Guards: 600 mm high, to be used on whips.

2.7 BONEMEAL

.1 Bone meal: Raw bone meal, commercial brand, finely ground, with minimum analysis of 2% and 11% phosphoric acid.

2.8 LIME

.1 Lime (used where pH of topsoil is less than 6.0): Limestone containing minimum 85% of calcium and magnesium carbonates combined, finely ground to pass number 10 mesh sieve, with minimum one-half (1/2) passing number 100 mesh sieve.

.2 Rate of application will be determined according to pH of topsoil.

2.9 MANURE

.1 Well-rotted, unleached sheep or cattle manure; free from harmful chemicals and other injurious substances and sawdust, shavings or similar refuse; at least eight (8) months old, but no more than two (2) years old and with no more than 25% straw, leaves or other acceptable materials for planting use.

2.10 COMPOST

.1 Decomposing organic matter such as cow manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability, and contaminant requirements.

.2 Processed organic matter containing 40% (by dry weight) or more organic matter as determined by Walkley-Black or Loss on Ignition (LOI) test.

.3 Product will be sufficiently decomposed (i.e. stable) so that further decomposition does not adversely affect plant growth (C:N ratio below25) and contain no toxic or growth inhibiting contaminates.

.4 Composted bio-solids: To CCME Guidelines for Compost Quality, Category A.

2.11 FERTILIZER

.1 Fertilizers: Commercial, complete, of neutral character; in granular, packet, or pellet form, 75% of nitrogen will be slow-release form, 50% of the elements of which will be derived from organic sources.

.2 Fertilizer requirements:

.1 Trees: 10-6-4 at 1 kg per 25 mm of tree caliper or as outlined in planting soil analysis fertilizer recommendations.

.2 Planting Beds: 12-6-4 at 1 kg per cubic metre of planting soil or as outlined in planting soil analysis fertilizer recommendations.

.3 Slow-release and natural organic fertilizers will be incorporated into the planting soil. Quick-release fertilizers will be broadcast after planting and then watered in. Do not mix quick-release forms with the planting soil used to backfill the planting pit.

.4 Incorporate fertilizer into the planting soil mixture in quantities sufficient to overcome chemical deficiencies of soil identified by planting soil analysis report.

2.12 PLANTING BED, TREE AND SHRUB SAUCER MULCH

.1 Shredded pine bark mulch by Gro-Bark-derived from pine, shredded, free from twigs, leaves, branches, noxious weed seed and foreign material harmful to plant growth and other extraneous material. Mulch with artificial dyes will be rejected.

.2 The Contractor will provide a sample of the above or approved equivalent mulch sources for review and approval by Contract Administrator prior to delivery of mulch to the site.

.3 The Contractor will be responsible for pick-up and delivery of approved mulch from source of supply to the site.

2.13 ROOT STIMULANT

.1 “Wurzil” root stimulant dip by The Professional Gardener Co. Ltd., 915-23rd Avenue S.E., Calgary, Alberta, T2G 1P1, telephone (403) 263-4200 or approved equivalent.

2.14 WATER

.1 Water will be potable and free of impurities and chlorine that would inhibit germination and growth.

.2 Water temperature will not be more than 10°C below the ambient air temperature.

.3 The Contractor may obtain water from the from an approved source as per the City of Winnipeg Water By-law and will make their own arrangements.

.4 Water tanks used for the application of water will be clean and free of contaminants that will be hazardous to the growth and development of plant material or to the general environment.

.5 Pumps used for watering plant material will be capable of reaching the limits of the site. The outlet end of the hose will be 25 mm in diameter with a quick shut-off valve connected to a functioning water injection pipe. The outlet end of the hose must be vandal-resistant or equipped with “anti-vandal” system.

2.15 WOODEN SURVEY STAKE/TREE/SHRUB LAYOUT

.1 Wood stake measuring 600 mm in length. Colour flagging tape will be used to differentiate between stake markers.

3 Execution

3.1 EXAMINATION

.1 Planting work will be carried out to conform to the best horticultural practices.

.2 Ensure that grading and backfilling has been completed in accordance with the Contract Drawings.

.3 Examine the site before commencing the Work and inform Contract Administrator if site conditions will not permit the completion of work of this Section as specified.

.4 Keep the site well drained. Keep landscape excavations dry.

.5 Do not install plant material until it has been accepted by Contract Administrator.

.6 Do not remove labels from plants until they have been inspected and accepted after planting by Contract Administrator.

.7 Clean up immediately soil or debris spilled onto pavement and dispose of deleterious materials off-site, at no additional cost to Contract Administrator.

.8 Ensure that barrier fencing is in place to protect existing vegetation being retained prior to commencing cultivation of planting areas.

.9 Locate and verify the existence of all utilities prior to starting planting operations.

3.2 LOCATION OF PLANTS

.1 Stake the position of plant material and planting beds as shown on the Planting Plan unless obstructions are encountered, in which case notify Contract Administrator. The location of trees and planting beds, where indicated, are approximate and may require adjustments in the field due to site conditions. The staked location of plant material will be review by Contract Administrator. Excavation will commence following Contract Administrator inspection and approval of staking.

.2 Trees and Shrubs: The location of trees and shrubs has been defined on the Contract Drawings. Refer to the Tree, Shrub and Ground Cover Plant List for quantities designated by Planting Area.

.1 All shrubs will be situated within a common planting bed unless otherwise noted or illustrated.

.3 Request Contract Administrator to observe and approve of new planting locations, topsoil placement and grading. Adjust as necessary before planting begins.

.4 Any discrepancies between the quantities shown and the plant list shall be reported to the Contract Administrator for direction.

3.3 PREPARATION

.1 Planting Soil: Delay mixing of fertilizer into planting soil if planting will not follow the preparation of planting soil within three (3) days.

.2 Excavation for Planting:

.3 Excavate for oversized tree pits and continuous soil corridors to the extents shown on the Planting Plan.

.1 Excavate for the shrub beds to the limits shown on the Planting Plan to a depth of 450 mm.

.4 Dispose of unsuitable and excess excavated material from tree pits and planting beds at no additional cost to Contract Administrator.

.5 All subsoil compacted during construction activities are to be scarified to the satisfaction of the Contract Administrator prior to placement of topsoil.

3.4 PLANTING

.1 Plant material will not be placed in the planting pit until evidence of frost has left the ground.

.2 Set plants plumb so that they are in the same relationship to finished grade, after settlement, as they were in the nursery or pot.

.3 Face plants to give best appearance when viewed from prime vantage points and prominent views (sidewalk, building, street) to the acceptance of Contract Administrator.

.4 Do planting in a continuous operation, completing total areas including mulching rather than focusing on completing individual species.

.5 Plant trees before planting surrounding areas with smaller shrubs and seeding.

.6 B&B Plants: Place in pit by lifting and carrying by its ball (do not lift by branches or trunk). Lower into pit and place root ball on compacted ground. Set straight in pit center with tip of root ball 75 mm above the adjacent finish grade.

.7 Plants are not to be installed or transplanted during extreme heat, drought or other undesirable conditions. The contractor is not to proceed in uncertainty. Contact the Contract Administrator for direction.

.8 Do not plant in drainage swales. Where proposed planting locations conflict with constructed swales, contact the Contract Administrator for direction.

3.5 BACKFILLING

.1 Backfill with planting soil in maximum 150 mm lifts and tamp placed planting soil to remove air pockets between lifts. Take care not to injure root system. When excavation is two-thirds (2/3) full, water thoroughly before placing remainder of backfill to eliminate air pockets. When the planting pit has been backfilled to finished grade, the final backfill layer will be used to form an earthen berm/saucer around the outside perimeter of the planting pit. The berm/saucer will be a maximum of 100 mm high and a maximum of 150 mm wide. The berm/saucer will be formed using the excavated soil material. If the pit is on a slope, the lower edge and sides will be built up to contain and hold water. Water immediately after completion of backfilling.

.2 Balled and Burlapped (B&B)/Wire Basket (W.B.) Plants:

.1 Remove synthetic material prior to backfilling.

.2 Partially backfill pit to support plant.

.3 Backfill in maximum 150 mm lifts and compact to remove air pockets until planting pit is one-third (1/3) full.

.4 Remove burlap and binding from sides and top one third of root ball. Do not pull burlap from under root balls. Remove upper one-third (1/3) of wire basket from entire circumference from W.B. plants.

.5 When excavation is approximately two-thirds (2/3) full, water thoroughly before placing remainder of backfill to eliminate air pockets. Complete backfilling in 150 mm lifts until finished grade is achieved.

.6 Cover the top of the root ball with soil and mulch.

.7 Establish tree saucer and water as outlined above.

.8 Provide an earth saucer at the base of individual trees and shrubs. Diameter of saucer to correspond to planting pit diameter as outlined on planting detail drawings.

3.6 STAKING

.1 All trees will be staked and tied immediately following planting to ensure vertical alignment and plant stability in accordance with Contract Drawings.

.2 Staking: Support deciduous trees 40 mm in caliper and less with one (1) stake. For deciduous trees with a caliper greater than 40 mm use two (2) stakes spaced equally about each tree in line with the tree trunk. Support coniferous trees up to 1.5 metres in height with two (2) stakes spaced equally about each tree in line with tree trunk. Support conifers greater than 1.5 metres in height with three (3) stakes spaced equally about each tree.

.3 Remove stakes and ties at the end of the warranty period.

3.7 FERTILIZER

.1 Add as top dressing depending on plant size and manufacturer's recommendations upon completion of planting operation or during the guarantee period.

3.8 MULCH INSTALLATION

.1 Immediately after planting, prior to the initial watering and seeding, install mulch within two (2) days after installation of plant material.

.2 Mulch will be applied in a uniform continuous blanket to the surface area surrounding each individual tree and shrub. Depth of mulch will be 75 mm (after settlement). Excess mulch will be turned over to Parks Canada for future adjustments.

.3 For trees, the mulch surface area will extend over the full extent of the planting pit and the earth berm/saucer and include an additional 300 mm radius beyond the circumference of the earth berm/saucer.

.4 Keep mulch 150 mm to 250 mm away from the trunk of plant material to prevent rodent nesting and disease (rot).

.5 Saturate the planting area with water after placing mulch.

3.9 WATERING

.1 Watering of plant material will commence immediately following installation. Apply sufficient water to saturate the root zone.

.2 Initial watering will be uniformly applied to each individual tree by two injection applications directly into the soil. Both injections will be located at the outer edge of the planting pit and will penetrate the ground to a depth of 450 mm. The second injection will be 180° from the initial injection.

.3 Water will be uniformly applied to avoid dislocating mulch, soil, and plant material.

.4 Do not overwater or drown plants.

.5 Keep plants well watered to ensure a vigorous, healthy growing condition during establishment period.

.6 The Contractor will maintain appropriate hydrological conditions using available water or imported potable water as required maintaining plant material in a vigorous, healthy growing condition.

3.10 PRUNING AND REPAIR

.1 All pruning will be carried out in accordance with Agriculture Canada Publication 1507-1977 "The Pruning Manual".

.2 Prune only after planting and in accordance with standard horticultural practice to preserve the natural character of the plant. Perform in the presence of Contract Administrator.

.3 Remove dead wood, suckers and broken or injured branches.

.4 Do not remove leaders. Do not plant trees without a prominent, vigorous leader.

.5 Use sharp, clean tools. Make cuts smooth, clean, and flush to base members. Leave no stubs.

.6 Cut back cambium to living tissue where cuts are made and at bruises, scars, and other injuries. Shape wood to prevent the retention of water.

3.11 WEED CONTROL

.1 Maintain a weed-free condition within planting areas.

3.12 PROTECTION OF INSTALLED WORK

.1 Protect planting areas and plants against damage for the duration of the maintenance period.

.2 All areas of disturbed soil must be stabilized with erosion control measures and/or seeded with noted seed immediately upon completion of work. Provide erosion matting/blankets with full biodegradable components.

3.13 ADJUSTMENT AND REPLACEMENT

.1 Perform adjustment and replacement work with materials of the same type and quality as outlined in the Plant List(s) on Contract Drawings. Replacement work will have a guaranty of the same length with the same conditions as outlined in this Specification. Date of renewed guarantee will be from the time of approval of replacement work. The Contractor will document replacement materials on the Record Drawings identifying the plant material location, plant species name, quantity, reason for replacement and date of replacement. A copy of replacement work carried out will be provided to Contract Administrator within fifteen (15) working days of Substantial Performance of the Work.

3.14 WATERING DURING THE MAINTENANCE PERIOD

.1 Refer to Section 32 93 10 - Landscape Maintenance for extra watering required during the warranty period.

3.15 PAYMENT

.1 Include the cost of furnishing all labour, materials, tools, equipment, and incidentals necessary to supply and plant trees, shrubs, perennials and grasses, as shown on drawings and as specified in Section 32 93 53 – Planting of Trees, Shrubs and Ground Cover.

.2 Measurement to be made per each tree, shrub, perennial and grass.

.3 Payment will be based on the quantity of planted trees, shrubs, perennials and grasses.

.4 Notwithstanding supplemental conditions clause D30, Payment;

.1 Payment for this specification section shall be in accordance with the following:

.1 Sixty-five (65%) percent of quantity following supply and placement

.2 Remaining thirty-five (35%) percent of quantity following termination of the maintenance period.

END OF SECTION

1 GENERAL

1.1 RELATED SECTIONS

.1 Specific reference is made to the following sections:

.1	Section 01 33 00	Submittal Procedures
.2	Section 26 05 00	Basic Electrical Materials and Methods
.3	Section 26 05 27	Grounding - Primary
.4	Section 26 12 11	High Voltage Switch and Fuse
.5	Section 26 41 00	Lightning Arrester

1.2 CODES AND STANDARDS

.1	CSA C22.3 No. 1	Overhead Systems
.2	CSA G12	Zinc-coated Steel Wire Strand
.3	CSA C411.5	Dead-End/Suspension Composite Insulators for Overhead Lines ≤ 75kV
.4	CSA C411.5	Line Post Composite Insulators for Overhead Lines ≤ 75kV
.5	CSA C83	Communication and Power Line Hardware
.6	CSA O15-15	Wood Utility Poles and Reinforcing Stubs
.7	CSA O80	Wood Preservation
.8	ANSI C29.17	Composite Line Post Type Insulators
.9	ANSI O5.3	Solid Sawn Wood Crossarms, Braces and Ground Wire Moulding: Specifications and Dimensions

.10 ANSI/NETA Acceptance Testing Standard

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00, Submittal Procedures.

.2 Product Data:

.1 Provide Manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Approval Documents and Drawings:

.1 Submit drawings stamped and signed by professional engineer registered in the Province of Manitoba indicating:

.1 Materials.

.2 Method of anchorage.

.3 Number of anchors.

.4 Supports.

.5 Reinforcement.

.6 Assembly details.

.7 Accessories.

.4 Closeout Submittals:

.1 Provide submittals in accordance to Section 01 78 00 – Closeout Submittals.

.2 Operation and Maintenance (O&M) manual(s) shall be provided the quantities and formats required by Section 01 78 23, Operation and Maintenance Data.

.3 The O&M manual shall include, but not limited to, the following:

.1 Production test certificates signed by Manufacturer certifying that materials comply with specified performance characteristics and physical properties,

.2 Certified copies of reviewed test data and reports,

.3 Certified, Signed and Approved drawings,

.4 Product submittals,

1.4 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 45 00 – Quality Control.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and assembly procedures.

.2 Health and Safety Requirements: worker protection:

.1 Workers must wear gloves, respirators, dust masks, long sleeved clothing, eye protection, protective clothing where required when applying preservative materials.

.2 Workers must not eat, drink or smoke while applying preservative materials.

.3 Clean up spills of preservative materials immediately with absorbent material and safely discard to sanitary landfill.

.4 Workers must wear personal protective wear: hardhat and safety boots.

.3 Perform work to comply with provincial regulations.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address,

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer’s recommendations.

1.6 OPERATING CONDITIONS

.1 Provide all necessary safeguards and protection for optimal performance of the equipment.

.1	Location:	Outdoors
.2	Temperature:	-40°C to 40°C
.3	Relative Humidity:	20% to 100%
.4	Elevation:	239 m ASL
.5	Duty:	24 hours/day, 365 days/year.

2 PRODUCTS

2.1 MATERIALS

.1 Wood preservation: to CSA O80.

.2 Power line hardware: to CSA C83.

.3 Wood utility poles: to CSA O15-15,

.1 Min. Class 1, preservative CCA treated.

.2 Wood species: Western Red Cedar

.3 Pole heights as depicted in the Drawings.

2.2 CROSSARMS

.1 Wood crossarms shall be pressure or vacuum treated with CCA preservative.

.1 Dead-end / cable riser poles with double crossarms across the three (3) poles as depicted in the Drawings.

.2 Horizontally mounted primary isolating switches pole structure with double crossarms, and cross bracings as depicted in the Drawings.

2.3 INSULATORS

.1 Post type insulators

.1 Material: Composite Polymer

.2 Configuration: Gain base with vertical clamp top for trunnion bolted clamp.

.3 Nominal Rating: 66 kV

.4 Maximum Rating: 72.5 kV

.5 B.I.L: 350 kV

.2 Suspension/Dead-end insulators:

.1 Material: Composite Polymer

.2 Configuration: Clevis (Base) – Tongue (Line)

.3 Nominal Rating: 66 kV

.4 Maximum Rating: 72.5 kV

.5 B.I.L: 350 kV

2.4 GUYS AND ANCHORS

.1 Guy wire:

.1 Size: 16 mm diameter

.2 Material: Stranded, EHS Galvanized Steel

.2 Guy clamps: three-bolt heavy duty or preform grip type.

.3 Eye bolt: 19 mm thimble, length to suit, four hole guy straps and 16 mm machine bolt with square washer to attach guy wire to pole.

.4 Anchor rod: 19 mm diameter x 2.1 m long, galvanized steel with thimble eye.

.5 Anchor:

.1 Power installed screw anchor (PISA), double helix, 203.2 mm diameter.

.6 Guy guard: plastic, colored yellow, 2.7 m long.

2.5 PRIMARY OVERHEAD CONDUCTORS

.1 Bare aluminum conductors steel reinforced (ACSR) in accordance with CAN/CSA-C61089.

.2 ACSR 2/0 (Quail), as indicated in the Drawings.

2.6 HIGH VOLTAGE SWITCH AND FUSES

.1 Refer to Section 26 12 11.

2.7 LIGHTNING ARRESTER

.1 Refer to Section 26 41 00.

2.8 GROUND RODS, GROUND CONDUCTORS AND GRADIENT MAT

.1 Refer to Section 26 05 27.

3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Install electrical pole lines and hardware in accordance with manufacturer's written instructions recommendations and specifications, including product technical bulletins, handling, storage and installation instructions and datasheets.

3.2 PREPARATION OF POLES

.1 Where poles require shortening and trimming, cut piece from top only.

.2 Roof top of poles with single slope beveled top.

.3 Treat roof top, gains, bored holes with preservative before assembly.

.4 Cut parallel plan crossarm gains in face of pole for single and double arming, spacing as indicated.

.5 Bore hole in centre of each gain for crossarm bolt.

.6 Drill crossarms for pins, through bolts, double arm bolts and brace bolts.

.1 Pre-drill treated crossarms to standard spacing.

.7 Install crossarms and braces where applicable.

3.3 INSTALLATION

.1 Locate and dig pole holes as indicated in the Drawings.

.2 Make holes large enough to allow space for tamping backfill.

.3 Set poles.

.4 Align poles with crossarms at right angles to pole line on straight runs.

.5 Set poles to maintain even grade.

.1 Allow for contour of terrain and do not exceed grading of 1.5m per pole.

.6 Replace backfill in 150mm layers.

.1 Tamp each layer and apply final layer to drain water away from pole.

.7 Cable riser poles:

.1 Locate and install guy wires and anchors at the dead-end/cable riser poles.

.2 Insert anchor at least 2.0m into ground to provide 20 kN holding capacity. Backfill and tamp in 150 mm layers.

.3 Install air terminal rods, insulators, power fuses, arresters, cable terminators and cable guard.

.4 Route new 2/0 ACSR conductors between devices, as depicted in the Drawings.

.5 Ground all the equipment to the ground grid as depicted in the Drawings.

.8 Dead-end and disconnect switch pole:

.1 Install disconnect switch and manual operating pipe and handle.

.2 Install line hardware and suspension insulators.

.3 Coordinate with Manitoba Hydro for terminating the incoming 66 kV line.

.4 Ground all the equipment and switch control mat to the ground grid as depicted in the Drawings.

3.4 FIELD QUALITY CONTROL

.1 Perform tests and field inspection for pole lines and hardware prior to energization in accordance with ANSI/NETA ATS.

.2 Use qualified tradespersons for installation, termination and testing of high voltage power lines, equipment and hardware.

.3 Engage an independent third-party testing firm to perform test and inspection of high voltage lines and equipment.

.4 Submit test result for Contract Administrator’s review prior to acceptance and energization.

3.5 CLEANING

.1 Upon completion, remove surplus materials, rubbish, tools and equipment.

3.6 WARRANTY

.1 The Vendor shall provide a complete warranty for all equipment, labor and materials for the arresters valid for a period of 2 years from the date following Substantial Completion of the Winnipeg North Garage Replacement construction contract.

END OF SECTION

1 GENERAL

1.1 RELATED SECTIONS

.1 Specific reference is made to the following sections:

.1	Section 01 33 00	Submittal Procedures
.2	Section 26 05 00	Basic Electrical Materials and Methods
.3	Section 26 05 27	Grounding - Primary
.4	Section 26 12 11	High Voltage Switch and Fuse
.5	Section 26 41 00	Lightning Arrester

1.2 CODES AND STANDARDS

.1	CSA C22.3 No. 1	Overhead Systems
.2	CSA G12	Zinc-coated Steel Wire Strand
.3	CSA C411.5	Dead-End/Suspension Composite Insulators for Overhead Lines ≤ 75kV
.4	CSA C411.5	Line Post Composite Insulators for Overhead Lines ≤ 75kV
.5	CSA C83	Communication and Power Line Hardware
.6	CSA O15-15	Wood Utility Poles and Reinforcing Stubs
.7	CSA O80	Wood Preservation
.8	ANSI C29.17	Composite Line Post Type Insulators
.9	ANSI O5.3	Solid Sawn Wood Crossarms, Braces and Ground Wire Moulding: Specifications and Dimensions

.10 ANSI/NETA Acceptance Testing Standard

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00, Submittal Procedures.

.2 Product Data:

.1 Provide Manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Approval Documents and Drawings:

.1 Submit drawings stamped and signed by professional engineer registered in the Province of Manitoba indicating:

.1 Materials.

.2 Method of anchorage.

.3 Number of anchors.

.4 Supports.

.5 Reinforcement.

.6 Assembly details.

.7 Accessories.

.4 Closeout Submittals:

.1 Provide submittals in accordance to Section 01 78 00 – Closeout Submittals.

.2 Operation and Maintenance (O&M) manual(s) shall be provided the quantities and formats required by Section 01 78 23, Operation and Maintenance Data.

.3 The O&M manual shall include, but not limited to, the following:

.1 Production test certificates signed by Manufacturer certifying that materials comply with specified performance characteristics and physical properties,

.2 Certified copies of reviewed test data and reports,

.3 Certified, Signed and Approved drawings,

.4 Product submittals,

1.4 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 45 00 – Quality Control.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and assembly procedures.

.2 Health and Safety Requirements: worker protection:

.1 Workers must wear gloves, respirators, dust masks, long sleeved clothing, eye protection, protective clothing where required when applying preservative materials.

.2 Workers must not eat, drink or smoke while applying preservative materials.

.3 Clean up spills of preservative materials immediately with absorbent material and safely discard to sanitary landfill.

.4 Workers must wear personal protective wear: hardhat and safety boots.

.3 Perform work to comply with provincial regulations.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address,

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer’s recommendations.

1.6 OPERATING CONDITIONS

.1 Provide all necessary safeguards and protection for optimal performance of the equipment.

.1	Location:	Outdoors
.2	Temperature:	-40°C to 40°C
.3	Relative Humidity:	20% to 100%
.4	Elevation:	239 m ASL
.5	Duty:	24 hours/day, 365 days/year.

2 PRODUCTS

2.1 MATERIALS

.1 Wood preservation: to CSA O80.

.2 Power line hardware: to CSA C83.

.3 Wood utility poles: to CSA O15-15,

.1 Min. Class 1, preservative CCA treated.

.2 Wood species: Western Red Cedar

.3 Pole heights as depicted in the Drawings.

2.2 CROSSARMS

.1 Wood crossarms shall be pressure or vacuum treated with CCA preservative.

.1 Dead-end / cable riser poles with double crossarms across the three (3) poles as depicted in the Drawings.

.2 Horizontally mounted primary isolating switches pole structure with double crossarms, and cross bracings as depicted in the Drawings.

2.3 INSULATORS

.1 Post type insulators

.1 Material: Composite Polymer

.2 Configuration: Gain base with vertical clamp top for trunnion bolted clamp.

.3 Nominal Rating: 66 kV

.4 Maximum Rating: 72.5 kV

.5 B.I.L: 350 kV

.2 Suspension/Dead-end insulators:

.1 Material: Composite Polymer

.2 Configuration: Clevis (Base) – Tongue (Line)

.3 Nominal Rating: 66 kV

.4 Maximum Rating: 72.5 kV

.5 B.I.L: 350 kV

2.4 GUYS AND ANCHORS

.1 Guy wire:

.1 Size: 16 mm diameter

.2 Material: Stranded, EHS Galvanized Steel

.2 Guy clamps: three-bolt heavy duty or preform grip type.

.3 Eye bolt: 19 mm thimble, length to suit, four hole guy straps and 16 mm machine bolt with square washer to attach guy wire to pole.

.4 Anchor rod: 19 mm diameter x 2.1 m long, galvanized steel with thimble eye.

.5 Anchor:

.1 Power installed screw anchor (PISA), double helix, 203.2 mm diameter.

.6 Guy guard: plastic, colored yellow, 2.7 m long.

2.5 PRIMARY OVERHEAD CONDUCTORS

.1 Bare aluminum conductors steel reinforced (ACSR) in accordance with CAN/CSA-C61089.

.2 ACSR 2/0 (Quail), as indicated in the Drawings.

2.6 HIGH VOLTAGE SWITCH AND FUSES

.1 Refer to Section 26 12 11.

2.7 LIGHTNING ARRESTER

.1 Refer to Section 26 41 00.

2.8 GROUND RODS, GROUND CONDUCTORS AND GRADIENT MAT

.1 Refer to Section 26 05 27.

3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Install electrical pole lines and hardware in accordance with manufacturer's written instructions recommendations and specifications, including product technical bulletins, handling, storage and installation instructions and datasheets.

3.2 PREPARATION OF POLES

.1 Where poles require shortening and trimming, cut piece from top only.

.2 Roof top of poles with single slope beveled top.

.3 Treat roof top, gains, bored holes with preservative before assembly.

.4 Cut parallel plan crossarm gains in face of pole for single and double arming, spacing as indicated.

.5 Bore hole in centre of each gain for crossarm bolt.

.6 Drill crossarms for pins, through bolts, double arm bolts and brace bolts.

.1 Pre-drill treated crossarms to standard spacing.

.7 Install crossarms and braces where applicable.

3.3 INSTALLATION

.1 Locate and dig pole holes as indicated in the Drawings.

.2 Make holes large enough to allow space for tamping backfill.

.3 Set poles.

.4 Align poles with crossarms at right angles to pole line on straight runs.

.5 Set poles to maintain even grade.

.1 Allow for contour of terrain and do not exceed grading of 1.5m per pole.

.6 Replace backfill in 150mm layers.

.1 Tamp each layer and apply final layer to drain water away from pole.

.7 Cable riser poles:

.1 Locate and install guy wires and anchors at the dead-end/cable riser poles.

.2 Insert anchor at least 2.0m into ground to provide 20 kN holding capacity. Backfill and tamp in 150 mm layers.

.3 Install air terminal rods, insulators, power fuses, arresters, cable terminators and cable guard.

.4 Route new 2/0 ACSR conductors between devices, as depicted in the Drawings.

.5 Ground all the equipment to the ground grid as depicted in the Drawings.

.8 Dead-end and disconnect switch pole:

.1 Install disconnect switch and manual operating pipe and handle.

.2 Install line hardware and suspension insulators.

.3 Coordinate with Manitoba Hydro for terminating the incoming 66 kV line.

.4 Ground all the equipment and switch control mat to the ground grid as depicted in the Drawings.

3.4 FIELD QUALITY CONTROL

.1 Perform tests and field inspection for pole lines and hardware prior to energization in accordance with ANSI/NETA ATS.

.2 Use qualified tradespersons for installation, termination and testing of high voltage power lines, equipment and hardware.

.3 Engage an independent third-party testing firm to perform test and inspection of high voltage lines and equipment.

.4 Submit test result for Contract Administrator’s review prior to acceptance and energization.

3.5 CLEANING

.1 Upon completion, remove surplus materials, rubbish, tools and equipment.

3.6 WARRANTY

.1 The Vendor shall provide a complete warranty for all equipment, labor and materials for the arresters valid for a period of 2 years from the date following Substantial Completion of the Winnipeg North Garage Replacement construction contract.

END OF SECTION

1 General

1.1 REFERENCE STANDARDS

.1 ANSI American National Standards Institute

.1 ANSI/ASME B30.11, Safety Standard for Monorails and Underhung Cranes.

.2 ANSI/ASME B30.16 Safety Standard for Overhead Hoists (Underhung).

.2 CSA

.1 CSA B167, Overhead Cranes, Gantry Cranes, Monorails, Hoists and Jib Cranes.

.2 CSA C22.1, Canadian Electrical Code, Part 1 Safety Standard for Electrical Installation, Section 40.

.3 CSA C22.2 No. 33-M, Construction and Test of Electric Cranes and Hoists.

1.2 SUBMITTALS

.1 Submit the following product data and shop drawings in one package.

.1 Submit in accordance with Section 01 33 00.

.2 Shop Drawing(s): indicating:

.1 Demonstration of compliance with specified requirements.

.2 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.

.3 Product storage, handling and installation requirements.

.4 Source quality control test reports.

.5 Fabrication details.

.3 Calculation to demonstrate required quantity, location and spacing of festoon track support. Bumper forces.

.2 Commissioning submittals:

.1 Commissioning Plan,

.2 Commissioning Procedures,

.3 Certificate of Readiness,

.4 Deficiency Report and

.5 Commissioning Closeout Report.

1.3 CLOSEOUT SUBMITTALS

.1 Submit following for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 00:

.1 Identification: Manufacturing name, type, year, serial number, number of units, capacity, and identification of related systems.

.2 Functional description detailing operation and control of components.

.3 Performance criteria and maintenance data.

.4 Operating instructions and precautions.

.5 Safety precautions.

.6 Component parts availability including names and addresses of spare part suppliers.

.7 Consumables.

.8 Lubrication schedule indicating lubrication points and type of lubricant recommended.

.9 Maintenance and troubleshooting guidelines/protocol, and recommended equipment for analysis and repair.

.10 List of items submitted to Commission's Representative as required: Keys, tools, special devices, maintenance materials.

1.4 QUALITY ASSURANCE

.1 Manufacturer shall have a minimum of 10 years of continuous design and fabrication of this type of equipment and systems for the Canadian commercial/industrial market.

.2 Installation shall be performed by or under the direct supervision of qualified red seal tradesperson for the type of work provided. Installation shall be site reviewed by authorized manufacturer's representative.

.3 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning on-site installation, with contractor's representative and Contract Administrator to verify project requirements.

.4 Manufacturer's representative to:

.1 Supervise:

.1 Installation of equipment.

.2 Start-up testing.

.3 Performance verification testing.

.4 Commissioning.

.2 Certify installation.

.3 Conduct training sessions.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect garage systems equipment from scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 Products

2.1 MONORAIL HOIST

.1 General:

.1 Underhung monorail hoist in accordance with ANSI/ASME B30.11 and B30.16 standards.

.2 CSA approved and labelled.

.3 Design Duty: heavy duty industrial service, Hoist Manufacturing Institute H4 rated, two speed hoist, single speed trolley.

.2 Capacity, Performance and Selection Data:

.1 Refer to the drawings and schedules

.3 Monorail and end stops:

.1 Monorail beam and installation by structural.

.2 End Stops: Refer to structural Drawings and Section 05 12 23.

.4 Trolley:

.1 Coordinate configuration with monorail beam.

.2 Electric motorized trolley.

.3 Self-aligning, low headroom type

.4 Rigid lug hoist suspension.

.5 Yokes: one piece cold formed steel with bolts through side of yoke.

.6 Bearings: wheels equipped with precision ball bearings.

.7 Wheels: hardened universal, to suit beam profile.

.8 Acceptable product:

.1 Hoist manufacturer's recommended product.

.5 Hoist:

.1 Electric powered.

.2 Lift Chain:

.1 Hardened forged alloy steel, approved for lifting applications.

.3 Load Hook:

.1 Drop forged, heat treated steel with spring latch and 360 deg. permanently lubricated thrust bearing.

.4 Gear train:

.1 Machined and heat treated gears lubricated with non-oxidizing grease and lifetime permanently lubricated ball bearings.

.5 Lift wheel:

.1 Precision machined and heat treated alloy steel with hardened chain guides.

.2 Forged 10-pocket oblique lay lift wheel for constant chain speed and smooth operation.

.6 Housing and Cover:

.1 Cast aluminum alloy with integral frame and housing design.

.7 Overload (capacity) Protection:

.1 Friction clutch assembly for positive overload protection.

.2 Automatically stops hoist when overloading occurs.

.8 Upper and Lower Limit Switches:

.1 Standard screw type.

.2 Factory set for full hook travel, easily adjustable for any lifting positions.

.9 Hoist Break:

.1 Disc type electric hoist brake holds with loss of power.

.10 Hoist Motor

.1 Heavy duty, 30 minute rating and with regenerative braking.

.11 Chain Container:

.1 Metal chain container for slack chain storage,

.2 One pin attachment, security cable,

.3 Sized to suit lifting chain.

.12 Acceptable product:

.1 Kito

.2 C/M

.3 Approved equivalent.

.6 Controls - General:

.1 Completely enclosed 120 V control circuit with integral transformer.

.2 Includes contactors, coils and limit switch control components.

.7 Radio remote Control System

.1 Trolley and hoist control for each individual monorail installation.

.2 Programmable, Licence-free operation

.3 Radio Frequency, minimum 62 user programmable channels.

.4 20 bit based identification coding.

.5 Automatic frequency selection

.6 Automatic time lapse shutdown (e.g. 1 minute inactive)

.7 E-stop to shut off transmitter and receiver main power

.8 Transmitter:

.1 Sealed NEMA 4 rated, IP66 hand held transmitter.

.2 Impact resistant, nylon/fiberglass rugged housing.

.3 Ergonomic shape.

.4 Automatic shut down upon dropping of transmitter.

.5 Alkaline battery powered.

.6 Snap action contacts for UP/DOWN operation.

.7 Status LED Indication.

.1 Battery condition

.2 Power on

.3 Transmitter on Standby

.4 Signal transmitted

.8 Minimum controls:

.1 E-stop button

.2 Power key switch

.3 Hoist Up (2 speed)

.4 Hoist Down (2 speed)

.5 Trolley Left (2 speed)

.6 Trolley Right (2 speed)

.9 Receiver:

.1 To match transmitter

.2 Automatic channel scanning

.3 Minimum LED Indications:

.1 Power

.2 Status

.3 SQ – Communications confirmation

.10 Acceptable product:

.1 Magnetek EX2 series

.2 Approved equivalent

2.2 FESTOON SYSTEM

.1 Industrial duty box track type for hoist and trolley power cables.

.2 Box Track Channel:

.1 Length: Segments to suit installation, refer to drawings.

.2 Construction: rugged, industrial duty, to suit applied load.

.3 Splice joints: as required to suit length.

.3 Power Cable:

.1 Flat with PVC jacket.

.2 Length to suit installation with 1m deep loops.

.3 Number of conductors and gauge to match hoist power requirements.

.4 Bushings and connectors as required for connecting flat cable to power wire and hoist.

.4 Other components to suit installation:

.1 Trolleys:

.1 Plated steel body

.2 Steel ball bearing rollers/wheels

.2 Lead and cable carriers:

.1 Galvanized, saddle design for flat cable with steel shielded ball bearing wheels.

.3 End clamps and stops.

.4 Hanger channels and anchors.

.5 Hangers: in accordance with Section 20 05 29.

.6 Acceptable product:

.1 Conductix-Wampfler

2.3 FINISH AND IDENTIFICATION

.1 The complete hoist shall be given the appropriate number of coats of anti-corrosion primer and finish paint to protect surface from environmental damage.

.2 Type of paint and colour of final coat shall be according to manufacturer's standard.

.3 Field Touch Up: Use compatible materials to match original finish.

.4 Identification:

.1 Equipment Manufacturer's Nameplates:

.2 Locate nameplates for easy reading.

.3 Type 304 stainless steel, minimum 0.64 mm thick with machine engraved upper case black filled lettering.

.4 Mount manufacturer's nameplate on each piece of equipment, mechanically fastened using stainless steel rivets or screws.

.5 Fabricate nameplates to withstand wear or deterioration of lettering in located environment.

.6 Indicate:

.1 Manufacturer's name.

.2 Equipment model.

.3 Serial number.

.4 Performance Data.

.5 Electrical data: including voltage, cycle, phase, power, motor size.

.6 Service Information.

.7 Date of Manufacturing.

.7 Install identifying label showing City's equipment identification.

.8 Affix approval label/registration plates (e.g. CSA, ULC or local Hydro Special Approval) as required by authority having jurisdiction.

3 Execution

3.1 PREPARATION

.1 Perform critical Site dimensions and make necessary adjustments to ensure tolerances and clearance maintained.

3.2 MONORAIL HOIST

.1 General:

.1 Install in accordance with referenced standards and reviewed Shop Drawings.

.2 Ensure design capacity labels are visible from all operating sight lines.

.3 Finish: provide field touch up as required match original finish.

.4 Install all components and accessories in accordance with manufacturer's installation instructions and recommendations.

.2 Monorail and End Stops

.1 Coordinate monorail beam installation with Section 05 12 23 and in accordance with structural Drawings.

.2 Identify end stop locations and coordinate installation in accordance with Section 05 12 23 and structural Drawings. Ensure locations permit full travel of trolley and do not contact trolley wheels.

.3 Monorail maximum capacity of in kg's shall to be painted on the side of beams.

.3 Trolley:

.1 Coordinate installation with monorail beam type.

.2 Install only after monorail end stops are installed.

.3 Install prior to attaching hoist.

.4 Provide and install necessary spacers to suit monorail beam as required to ensure proper alignment.

.5 Hoist:

.6 Install lift chain and load hook and attach to trolley.

.7 Adjust upper and lower limit switches to suit operation. Coordinate operation of hoist with TTC and adjust as directed.

.4 Controls:

.1 As per manufacturer's requirements equipment.

3.3 FESTOON SYSTEM

.1 Install all components and accessories in accordance with manufacturer's installation instructions and recommendations.

.2 Identify required hanger locations and co-ordinate installation in accordance with Section 20 05 29.

.3 Cut cable to required length and provide connection to power feed and hoist.

.4 Quantity, location and spacing of festoon track supports established by manufacturer.

.5 Ensure smooth operation of festoon system with trolley movement. Adjust or modify as require achieving effortless operation.

3.4 TESTING AND CERTIFICATION

.1 All the tests shall be performed in accordance with the applicable design, performance, and safety standards.

.2 Factory Tests:

.1 Prior to shipment, fully assemble monorail hoist by manufacturer at manufacturer's shop for shop testing and parts match mark for reassembly on site.

.3 Field Tests:

.1 Monorail supplier to supply all required test weights.

.2 Assemble test apparatus for each capacity lift.

.3 Position test apparatus on trolley hoist and raise and lower to full design travel.

.4 On completion of monorail beam and hoist/trolley assembly installation, conduct following tests in presence of City. Provide 1 week advance notice:

.4 Running Test:

.1 All motions in all directions, including clearances, alignments and limit switches.

.2 Load Test in accordance with CSA B167:

.3 Monorail hoist to have each motion, holding brakes and travel brakes tested with hook carrying:

.4 Rated capacity: attain specified speeds during tests.

.5 125% of rated capacity: During this test specified speeds need not be attained but crane to show itself capable of dealing with overload without difficulty.

.5 Deflection Test:

.1 Demonstrate/measure for rated capacity.

.2 Measure vertical deflection of monorail beam.

.3 Vertical deflection of beam produced by weight of hoist assembly and rated load not to exceed the value specified by the manufacturer for the specified model or maximum allowed by applicable design specifications whichever is less.

.6 Brake Test in accordance with CSA B167:

.1 All brakes tested under full load conditions, from maximum speed to rest, three times in quick succession without overheating. Test brake by removing power from hoist under full load and down motion.

.7 Provide certification as required by Authorities Having Jurisdiction.

.8 Rectify any Work not meeting requirements of this Specification to satisfaction of TTC and at no additional costs to TTC for such Work.

.9 Schedule the Work to ensure successful completion of all testing minimum of seven calendar days prior to Substantial Performance.

.10 Submit copies of all test reports, including test results and readings, within 7 calendar days of completion of testing.

.11 Submit coopies of all certificates as required by the AHJ.

.12 Manufacturer's representative shall supervise hoist installation and submit letter of satisfaction upon acceptance.

3.5 COMMISSIONING

.1 Perform Commissioning in accordance with Sections 01 91 00 and 20 05 00.

.2 Verify operational and functional performance in general conformance with following outlines:

.3 Operational Performance Outline:

.1 Vertical Travel:

.2 Length of travel for hook and chain.

.3 Gearing is sufficiently quiet and lubrication is adequate.

.4 Clearance/interference.

.5 Limit switches.

.6 Speed.

.7 Brakes.

.8 Other.

.4 Horizontal Travel:

.1 Operation of trolley along monorail.

.2 Festoon operation with trolley.

.3 Clearance/interference.

.4 Alignment.

.5 Speed.

.6 End Stops.

.7 Other.

.5 Remote Control System:

.1 Buttons.

.2 Other.

.6 Functional Performance Outline:

.1 At full rated capacity:

.2 Vertical travel.

.3 Horizontal travel.

.4 Remote control station.

.5 Clearance/interference.

.6 Hoist limit switches.

.7 End stops.

.8 Others.

3.6 MAINTENANCE

.1 Perform maintenance in accordance with Section 20 05 00.

END OF SECTION