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SUMMARY OF WORK

1. GENERAL

1.1 Work Covered by Construction Contract Documents

.1 Work of this Construction Contract comprises generally of upgrading the UV Facility, including replacing the UV system, replacing gates, replacing existing roofing, improving ventilation, piping, road works, landscaping, electrical works, and construction of a storage building located at the City of Winnipeg North End Water Pollution Control Centre (NEWPCC).

.2 The Work includes, but is not limited to the following elements:

.1 Supply and install two (2) temporary bulkheads so that secondary effluent cannot flow through the UV system during construction. Remove once construction is over. Contractor to design bulkheads and provide Shop Drawings. The Contractor can add secondary bulkheads at their own expense if they are required for their work plan.

.2 UV system removal and installation is to be completed during a four (4) month shutdown of the existing disinfection system. At a minimum, two (2) channels must be fully functional and meeting licence requirements following the shutdown. All remaining work is to be done with isolation gates during operation of the facility.

.3 Supply and construct the new storage room, complete with piles, concrete pad, superstructure, electrical, mechanical, doors, overhead door, loading bay and plumbing.

.4 Install and replace the existing two (2) 4160V to 600 V and two (2) 4160 to 480 V transformers on the existing pad. These transformers have been prepurchased by the City. Depending upon the transformer supply schedule the transformer replacement may need to be sequenced. Bid to assume that the transformers will be delivered such that the transformers can be installed during the UV system shutdown and all transformers are de-energized simultaneously. If the transformers are not delivered on time, Contractor to temporarily connect the new motor control centres to the existing transformers and then sequentially replace the existing transformers with the new transformers. Additional work to temporarily connect and sequentially install will be paid by Cash Allowance #1. Contractor to provide a detailed cost breakdown upon request by the Contract Administrator. Cash Allowance #1 only includes additional work over and above the costs associated with the base bid as described in Appendix K.

.5 Supply and install fences and gates around the transformers.

.6 Supply and install a roll up door on the North side of the UV Facility.

.7 Supply and install two (2) ventilation fans for the UV channel, complete with controls.

.8 Replace existing roofing on existing UV Facility and tie into new storage room roof.

.9 Install new access road, and modify existing roads, complete with demolition.

.10 Install gravity flow access pipe complete with blind flanges in the UV effluent trough.

.11 Supply and install three (3) monorails for removal of channel cover plates.

.12 Remove existing UV Systems in the three (3) channels and replace with new prepurchased UV systems from the City.

.13 Install all wiring, power supplies, fire alarms, panels, programming, instrumentation and controls required for operation of the new UV system. Submit Shop Drawing showing the intended hydraulic hose mounting and routing between the hydraulic system centre and each lamp bank for each channel. Hoses are provided by the UV system supplier. Submit Shop Drawing showing the intended routing for lamp cables between each lamp bank and its respective power distribution centre. Lamp cables are provided by the UV system supplier. Show lamp cables and hydraulic hoses when bank is in operational location, half way through its raised position, and when the bank is in its fully raised position.

.14 Remove and replace the existing switchgear for operation of the UV Facility with new prepurchased Motor Control Centers from the City.

.15 Upgrade the three (3) UV channels to fit the new prepurchased UV systems including changing water level elevation, grouting and securing them in place.

.16 Complete all electrical work, and controls for a fully functional and programmed UV System.

.17 Temporary services such as bulkheads in the UV channel and temporary power and water services.

.18 Install removeable channel covers between the UV systems in each channel.

.19 Remove and replace existing gates and actuators upstream of the UV systems in each of the three (3) channels. Gates and actuators have been prepurchased by the City.

.20 Remove and replace existing gates and actuators downstream of the UV systems in each of the three (3) channels. Gates and actuators have been prepurchased by the City.

.21 Supply and install a hatch to the east of the UV channels for access.

.22 Move piping and electrical as required for installation of new UV system.

.23 Supply and install all yard piping, fittings, couplings, transitions, connections, and valves.

.24 Complete all Site Work, Site grading, paving, parking areas and Site Utility Work.

.25 Provide all information to fill in the City of Winnipeg Asset forms such as Oracle Work and Asset Management (OWAM).

.26 Provide temporary power, and access to the existing site and adjacent sampling building during construction.

.27 All other auxiliary equipment, structures, and systems required to complete the Work.

.29 Abate, load, transport and dispose of all known hazardous excavated soil, requiring removal to complete the Work, prior to backfilling. This would be part of Cash Allowance #2.

1.2 Proposed Construction Plan

.1 Once the four (4) month UV system shutdown is complete, the system will be running to meet licence requirements. All remaining Work must be completed without a further shutdown and while a minimum of two (2) channels are fully operating. While operating, provide full safe access to the operators, maintenance and for sample collection.

.2 Co-ordinate Progress Schedule and milestones with the City and Contract Administrator during construction to minimize disruption as per Section 01 32 16.07 - Progress Schedule.

1.3 Contractor Use of Premises

.1 Co-ordinate use of premises under direction of Contract Administrator.

.2 Remove or alter existing Work to prevent injury or damage to portions of existing Work which remain.

.3 Repair or replace portions of existing Work which have been altered during construction operations to match existing or adjoining work, as directed by Contract Administrator.

1.4 City of Winnipeg Personnel Occupancy

.1 City of Winnipeg personnel will work around Site during entire construction period for execution of normal operations.

.2 Co-operate with City of Winnipeg personnel in scheduling operations to minimize conflict.

.3 Provide continual access to the existing UV Facility, before and after the 4-month shutdown, and Sampling Building throughout the entire construction period.

1.5 City Supplied Equipment

.1 The following items will be supplied by the City to the Contractor for installation, and integration into the Works.

.1 Depending upon the dates of delivery, some of these items may need to be sequenced for installation.

.2 UV Systems for the three (3) UV channels.

.3 Three (3) actuated gates upstream of the UV system and three (3) actuated gates downstream of the UV System.

.4 Two (2) 4160 V to 600 V and two (2) 4160V to 480 V transformers.

.5 480 V and 600 V Motor Control Centers.

1.6 Existing Services

.1 Where Work involves breaking into, diverting or connecting to existing piping, give fourteen (14) days notice via City work request. Carry out work at times as directed by governing authorities with minimum disturbance.

.2 Provide alternative routes for traffic.

.3 Before commencing Work, complete hydrovac to establish location and extent of service lines in area of Work and notify the Contract Administrator of findings. Submit a report a minimum of four (4) weeks prior to starting any excavation Work.

.4 Submit schedule to and obtain approval from the Contract Administrator for any shut-down or closure of active service or facility including power, wastewater, water and communications services. Adhere to approved schedule and provide notice to affected parties. Provide fourteen (14) days notice via City work request for all tie-ins and planned disruptions.

.5 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.

.6 Where unknown services are encountered, immediately advise Contract Administrator and confirm findings in writing.

.7 Record locations of maintained, re-routed and abandoned service lines.

.8 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

.9 The Contractor is to use hydrovac processes to identify all structures or pipes.

.10 Due to daily flow variation, some of the tie-ins may be required to be completed during the night or at other low flow periods.

1.7 Documents Required

.1 Maintain at job Site, one (1) copy of each document as follows:

.1 Construction Contract Drawings.

.2 Construction As-build Drawings.

.3 Specifications.

.4 Addenda.

.5 Reviewed Shop Drawings.

.6 List of Outstanding Shop Drawings.

.7 Change Orders.

.8 Other Modifications to Construction Contract.

.9 Field Test Reports.

.10 Copy of Approved Work Schedule.

.11 Health and Safety Plan and Other Safety Related Documents.

.12 Hazardous material management plan identifying hazardous materials, personal protective requirements and disposal arrangements.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

WORK RESTRICTIONS

1. GENERAL

1.1 Access and Egress

.1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

.2 Do not block access on north or the south side of the building except for coordinated actions. If necessary, provide a temporary road for access on the north side of the UV Facility.

.3 Ensure access to areas being used by other contractors in construction of the Headworks Facility.

1.2 Use of Site and Facilities

.1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Contract Administrator to facilitate work as stated.

.2 Provide access for operators to the UV Facility at all times.

.3 Provide access for operators to the effluent sampling building

.4 Where security is reduced by work provide temporary means to maintain security.

.5 Refer to Section 01 52 00 - Construction Facilities for information on sanitary facilities. Keep facilities clean.

.6 Closures: protect work temporarily until permanent enclosures are completed.

1.3 Alterations, Additions or Repairs to Existing Building

.1 Execute Work with least possible interference or disturbance to facility operations, and normal use of premises. Arrange with Contract Administrator to facilitate execution of Work.

1.4 Existing Services

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

.2 Where Work involves breaking into or connecting to existing electrical services, give the City fourteen (14) day notice via City work request for all tie-ins and planned disruptions throughout course of work. Interruption to disinfection processes require fourteen (14) days notice, and approval of the City. Keep duration of interruptions to a minimum. Carry out interruptions preferably during low flow times.

.3 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.5 Building Smoking Environment

.1 Comply with smoking restrictions. Smoking is not permitted.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

SUBSTITUTION PROCEDURES

1. GENERAL

1.1 Description

.1 Section includes administrative and procedural requirements for substitutions.

1.2 Definitions

.1 Substitutions for Cause: Changes proposed by the Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

1.3 Submittals

.1 Submit Shop Drawings in accordance with Section 01 33 00.

.2 Substitution Requests: Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

.1 Substitution Request Form: Use Form 01 25 00-1 to request substitution.

.2 Documentation: Show compliance with requirements for substitutions and the following, as applicable:

.1 Justification for use of the proposed equivalent item(s), including evidence, as applicable, that Contract specified material, product, or equipment is unobtainable or unobtainable within an acceptable time for Contract completion.

.2 Statement indicating why specified product or fabrication or installation cannot be provided, if applicable. If the Contractor is proposing the substitution because of unavailability of the product, submit a letter from the manufacturer or distributor stating the product is unavailable with an explanation of why it is unavailable with the Form 01 25 00-1.

.3 Coordination information, including a list of changes or revisions needed to other parts of the Work, drawings and specifications, and to construction performed by City and separate contractors that will be necessary to accommodate proposed substitution.

.4 Detailed comparison of qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, electrical characteristics, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated and specified. Indicate deviations, if any, from the Work specified.

.5 Product data, including drawings and descriptions of products and fabrication and installation procedures.

.6 Certificates and qualification data, where applicable or requested.

.7 List of similar installations for completed projects with project names and addresses and names, telephone numbers, and addresses of engineers and owners.

.8 Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

.9 Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

.10 Cost information, including a proposal of change, if any, in the Contract Price.

.11 A prediction of any effects the proposed change will have on operation and maintenance costs, where applicable.

.12 Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is intended for applications indicated.

.13 Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

.3 Contract Administrator's Action: If necessary, Contract Administrator will request additional information or documentation for evaluation within five (5) Business Days of receipt of a request for substitution. The Contract Administrator will notify the Contractor of acceptance or rejection of a proposed substitution within fifteen (15) Business Days of receipt of request, or five (5) Business Days of receipt of additional information or documentation, whichever is later.

.1 Forms of Acceptance: Change Work Order, Proposed Change Notice, or Field Instructions for minor changes in the Work.

.2 Use product specified if Contract Administrator does not issue a decision on use of a proposed substitution within time allocated.

1.4 Material and Workmanship

.1 Whenever a material, article, system, or sub-system is specified or described by using the name and/or model of a proprietary product or trademark or the name of the manufacturer or vendor, the specified item shall establish the type, function, and quality required; it shall be understood that the words “or approved equal in accordance with B7” are implied whether or not they follow the proprietary enumeration.

.2 The Contract Administrator reserves the right to determine when proprietary items have no equivalency, and when uniformity of operations, interchangeability of parts, standard parts inventory, etc., are in the City’s best interest.

.3 Requests for review of equivalency will be considered upon submission of sufficient information as described herein, to allow complete review.

.4 Such requests will not be accepted from anyone other than the Contractor. Such submission must be made prior to purchase, fabrication, manufacture or use of the equivalent items under consideration.

.5 The Contractor is responsible for all delays caused by its failure to submit complete and accurate information with any request for approval of any material, article, system, or subsystem as an equivalent.

.1 Contractor Risk:

.1 If the Contractor includes in their Bid or later proposes any material, product, or equipment that they consider equivalent to that specified, the Contractor assumes all risk of any sort associated with acceptance or rejection of proposed equivalent items.

.2 The Contractor shall have no right to make claim based upon their Bid that includes a proposed equivalent item(s) of work which resulted in a lower Bid amount for said item(s) or lower total Bid.

.2 Equivalency:

.1 An item will be considered equivalent to the item specified if:

.1 It is equal or better in design and strength in all subparts, quality, reliability and durability, operation, maintenance, and serviceability, as applicable; and

.2 It is equal or better in specified parameters in performance in all respects for the specific function(s) indicated in the Contract.

.3 Supplemental Requirements:

.1 Any tests required by the Contract Administrator to establish quality and performance standards shall be promptly conducted by or through the Contractor at no additional cost to the City.

.2 The Contractor shall submit any additional data requested by the Contract Administrator for the equivalency review.

.3 The Contractor shall satisfactorily accomplish all changes, including any engineering associated with use of equivalent items, at no additional cost to the City.

.4 The Contractor shall have no right of appeal to any decision rejecting the equivalency of any item.

1.5 Quality Assurance

.1 Comply with the requirements specified in Section 01 45 00 - Quality Control.

.2 Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers at no cost to the City.

1.6 Procedures

.1 Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

2. PRODUCTS

2.1 Substitutions

.1 Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than fifteen (15) Business Days prior to time required for preparation and review of related submittals.

.1 Conditions: Contract Administrator will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Contract Administrator will return requests without action, except to record noncompliance with these requirements:

.1 Requested substitution is consistent with the Contract Documents and will produce specified and indicated results.

.2 Requested substitution provides sustainable design characteristics that specified product provided.

.3 Substitution request is fully documented and properly submitted.

.4 Requested substitution will not negatively affect Contractor's construction schedule.

.5 Requested substitution has received necessary approvals of Authorities Having Jurisdiction.

.6 Requested substitution is compatible with other portions of the Work.

.7 Requested substitution has been coordinated with other portions of the Work.

.8 Requested substitution provides specified warranty.

.9 If requested substitution involves more than one contractor, requested substitution has been coordinated, signed and confirmed with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

3. EXECUTION

3.1 Contract Closeout

.1 Provide in accordance with Section 01 78 00 - Closeout Submittals.

Form 01 25 00-1
SUBSTITUTION REQUEST

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to design, including Contract Administrator design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

Contract Administrator REVIEW AND ACTION

☐ Substitution approved – Make submittals in accordance with Specification Section 01 25 00.

☐ Substitution approved as noted – Make submittals in accordance with Specification Section 01 25 00.

☐ Substitution rejected – Use specified materials.

☐ Substitution Request received too late – Use specified materials.

Signed by: _____ Date: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ Contract Administrator ☐
Other: _____

_____

_____

_____

_____

_____

Form 01 25 00-1 (Continued)
SUBSTITUTION REQUEST

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ Contract Administrator Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No. _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached – REQUIRED BY Contract Administrator

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Contract Administrator: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other part of Work: ☐ No ☐ Yes, explain _____

_____

Savings to Owner for accepting substitution: _____

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports _____

END OF SECTION

PAYMENT PROCEDURES FOR TESTING SERVICES

1. GENERAL

1.1 Testing Services

.1 The Contractor will pay for testing services as follows:

.1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.

.2 Inspection and testing performed exclusively for Contractor's convenience.

.3 Testing, adjustment and balancing of process equipment and systems, mechanical and electrical equipment and systems.

.4 Mill tests and certificates of compliance.

.5 Tests specified to be carried out by Contractor under supervision of Contract Administrator.

.6 Tests as specified to be carried out by Contractor in other Sections of these Specifications.

.7 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by Contract Administrator to verify acceptability of corrected work.

.8 Bacteriological testing or other testing required to confirm UV System during startup and commissioning.

.9 Compaction testing with a nuclear densometer or a standard proctor test.

.10 Standard proctor tests.

.11 Concrete testing as identified.

1.2 Contractor's Responsibilities

.1 Provide labour, equipment and facilities to:

.1 Provide access to Work for inspection and testing.

.2 Facilitate inspections and tests.

.3 Make good Work disturbed by inspection and test.

.4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.

.2 Notify Contract Administrator minimum seventy-two (72) hours in advance of operations to allow for witnessing of tests.

.3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

.4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by Contract Administrator.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

PROJECT MEETINGS

1. GENERAL

1.1 Administrative

.1 Schedule and administer project meetings throughout the progress of the Work at the call of the Contract Administrator.

.2 Prepare agenda for meetings.

.3 Distribute written notice of each meeting seven (7) days in advance of meeting date to Contract Administrator.

.4 Provide physical space and make arrangements for meetings.

.5 Preside at meetings.

.6 The Contract Administrator shall record the meeting minutes.

.7 Representative of the Contractor, Subcontractor and Suppliers attending the meetings will be qualified and authorized to act on behalf of party each represents.

1.2 Weekly Newsletter

.1 The Contractor shall prepare weekly newsletters (including the weekly look-ahead schedules attached to the newsletters) and e-mail a PDF copy to the Contract Administrator and the City every Monday morning.

.2 Newsletters shall summarize the Work completed the previous week and shall include pictures associated with this Work. A detailed description of the Work completed by all subcontractors/trades daily are to be included in the Newsletters, and not just the caption of the picture.

.3 Throughout the project, the City and Contract Administrator can request the raw (non- PDF) electronic copies of any newsletters, including pictures.

.4 At Substantial Performance, six (6) USB flash drives containing all of the raw (non-PDF) and PDF copies shall be provided.

.5 Any Work completed between Substantial Performance and end of Warranty shall also be included in newsletters and six (6) USBs updated at the end of the Warranty period to cover the entire project.

1.3 Pre-Construction Meeting

.1 Within fifteen (15) days after award of the Construction Contract, request a meeting and organize of parties in Construction Contract to discuss and resolve administrative procedures and responsibilities.

.2 Senior representatives of the Contract Administrator, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.

.3 Establish time and location of the meeting and notify parties concerned minimum five (5) days before meeting.

.4 Incorporate mutually agreed variations to Construction Contract Documents into Agreement, prior to signing.

.5 Agenda to include:

.1 Appointment of official representative of participants in the Work.

.2 Schedule of Work: in accordance with Section 01 32 16.07 - Progress Schedule.

.3 Schedule of submission of Shop Drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.

.4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.

.5 Delivery schedule of specified equipment.

.6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

.7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.

.8 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.

.9 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.

.10 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.

.11 Monthly progress claims, administrative procedures, photographs, hold backs.

.12 Appointment of inspection and testing agencies or firms.

.13 Insurances, transcript of policies.

1.4 Progress Meetings

.1 Schedule progress meetings twice a month during the course of Work and three (3) weeks prior to project completion.

.2 Contractor and Contract Administrator are to be in attendance.

.3 Notify parties minimum seven (7) days prior to meetings.

.4 Contract Administrator to record minutes of meetings and circulate to attending parties and affected parties not in attendance within seven (7) days after meeting.

.5 Agenda to include the following:

.1 Review, approval of minutes of previous meeting.

.2 Review of Work progress since previous meeting.

.3 Field observations, problems, conflicts.

.4 Problems which impede construction schedule.

.5 Review of off-site fabrication delivery schedules.

.6 Corrective measures and procedures to regain projected schedule.

.7 Revision to construction schedule.

.8 Progress schedule, during succeeding work period.

.9 Review submittal schedules: expedite as required.

.10 Maintenance of quality standards.

.11 Review proposed changes for effect on construction schedule and on completion date.

.12 Other business.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

PROGRESS SCHEDULE

1. GENERAL

1.1 Definitions

.1 Activity: element of the Work performed during the course of the Project. Activity normally has an expected duration, and an expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (GANTT Chart) (in Microsoft Project and PDF): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down the left side of chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars. Generally the Bar Chart shall be derived from commercially available computerized project management system.

.3 Baseline: original plan (for project, work package, or activity), plus or minus approved scope changes.

.4 Construction Work Week: Monday to Friday, inclusive, will provide five (5) day work week and define schedule calendar working days as part of Bar Chart (GANTT Chart) submission.

.5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project elements. Usually expressed as workdays or workweeks.

.6 Master Plan: summary-level schedule that identifies major activities and key milestones.

.7 Milestone: significant event in project, usually completion of major deliverable.

.8 Project Schedule or Schedule: planned dates for performing activities and the planned dates for meeting milestones. A dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

.9 Project Planning, Monitoring and Control System: overall system operated by the Contract Administrator to enable monitoring of project work in relation to established milestones.

1.2 Requirements for Working During the UV System Shutdown

.1 There is a Notice of Alteration to the Licence that allows shutdown of the UV system and bypass after the lift pumps for a 4-month period between October 18, 2025 and February 18, 2026. The actual 4-month shut down period may vary within those dates. The schedule provided by the Contractor must address this continuous work period in developing the schedule.

.2 The schedule of Work must include two (2) weeks of buffer time at the end of the schedule as part of the four (4) months.

.3 The UV Facility must be able to meet licence requirements at the end of the four (4) month period. All follow-up work must be done while online and while meeting the licence, as there is no second bypass period.

.4 This timeline may necessitate shift work if it cannot be completed during typical daytime construction hours.

.5 Indicate periods that you anticipate working longer hours.

1.3 Requirements

.1 Ensure Master Plan and Project Schedule are practical and remain within specified Construction Contract duration.

.2 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity durations to maximum of approximately ten (10) working days, to allow for progress reporting.

.4 Ensure that it is understood that Award of Construction Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this Construction Contract.

1.4 Action and Informational Submittals

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

.2 Submit to Contract Administrator within fourteen (14) working days of Award of Construction Contract, the Master Plan for planning, monitoring and reporting of project progress. The Master Plan is to be in the form of a Bar Chart (GANTT Chart).

.3 Submit Project Schedule in the form of a more detailed Bar Chart (GANTT Chart) to the Contract Administrator within five (5) working days of receipt of acceptance of Master Plan.

1.5 Master Plan

.1 Structure the schedule to allow orderly planning, organizing and execution of the Work as Bar Chart (GANTT Chart).

.2 The Contract Administrator will review and return revised schedules within five (5) working days.

.3 Revise impractical schedule and resubmit within five (5) working days.

.4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.6 Project Schedule

.1 Develop detailed Project Schedule derived from Master Plan.

.2 Ensure detailed Project Schedule includes as minimum the milestone activities and the following activities:

.1 Award.

.2 Shop Drawings, Samples.

.3 Permits.

.4 Mobilization.

.5 Excavation.

.6 Piling.

.7 Yard Piping.

.8 Backfill.

.9 Building footings.

.10 Structural Steel.

.11 Siding and Roofing.

.12 Interior Architecture (Walls, Floors and Ceiling).

.13 Install Bulkheads after low lift pumps prior to UV Channels.

.14 Install temporary heat and electrical feed.

.15 Install temporary power and utilities.

.16 Turn off lift pumps.

.17 Install access doors on north and east wall for access.

.18 Install concrete pad for storage building to east of the building.

.19 Install storage building.

.20 Receive prepurchased gates, UV systems, transformers, motor control centres and gates.

.21 Install bypass pipe to Headworks (by Headworks Contractor – Coordinate installation).

.22 Removal of three (3) upstream gates and replacement.

.23 Removal of UV systems in each channel and replacement.

.24 Installation of monorails for lifting.

.25 Installation of UV Channel ventilation.

.26 Installation of UV channel covers for each channel.

.27 Remove three (3) downstream gates and replace.

.28 Remove electrical, transformers and controls.

.29 Replace electrical, transformers and controls. Provide plan for sequencing the equipment switchout and replacement.

.30 Install piping for future Flushing water usage in future.

.31 Roofing.

.32 Remove bulkheads.

.33 Fencing for transformers.

.34 Landscaping.

.35 Process Equipment.

.36 Plumbing

.37 Lighting.

.38 Electrical.

.39 Process Piping.

.40 Controls.

.41 Heating, Ventilating, and Air Conditioning.

.42 Millwork.

.43 Fire Systems.

.44 Access Roads.

.45 Paving.

.46 Repair/upgrade existing roads.

.47 Start-up.

.48 Training.

.49 Commissioning.

.50 Manuals.

.51 Substantial Performance.

.52 As-builts.

.53 Total Performance.

1.7 Project Schedule Reporting

.1 Update Project Schedule weekly and in advance of Progress Meetings.

.1 Update shall reflect activity changes and completions, as well as activities in progress.

.2 On a monthly basis, include as part of Project Schedule, a narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.8 Project Meetings

.1 Discuss Project Schedule at regular Site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

.2 Weather related delays with their remedial measures will be discussed and negotiated.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CONSTRUCTION PHOTOGRAPHS

1. GENERAL

1.1 Construction Photographs

.1 Provide construction photographs pertinent to the Work as indicated and in compliance with Contract Documents.

.2 The Contractor must photographically document all areas and surrounding areas at all phases of the Contract including preconstruction, construction progress (weekly as a minimum) and post-construction.

.3 The Contractor must ensure that a digital camera is available at the Site for its own use and for the use of the Contract Administrator. The Contractor shall enlist the services of a professional photographer to take photographs of the various parts of the construction on a regular basis and when problems or matters of particular interest or importance arise.

.4 Copies of such photographs shall be retained on Site until completion of the Work and should be identified with the following information:

.1 Date when photograph was taken and by whom.

.2 Contract number.

.3 Contractor's name.

.4 Location (i.e.. grid lines).

.5 Direction of view.

.6 Description of the photograph and the work performed or being performed, and equipment tag no. and equipment description.

.7 Contractor's photo file number (so that each photo and negative may be readily identified).

.5 Deliver to the City and Contract Administrator two electronic copies on USB Sticks with photos by a minimum with an 8 megapixel camera. Video recording shall be at a minimum 1080p HD video recording (30 fps or 60 fps). The Contract Administrator may direct the Contractor to obtain additional photographic records of structures and features within the Site limit.

.6 The Contract Administrator shall have the right to select the subject matter and vantage point from which photographs are taken. Matters of importance or interest which are to be photographed include:

.1 After the execution of the Contract and before the Work at the Site is started, and again upon issuance of Substantial Performance of the Work, take photographs of the construction Site as well as the property adjacent to the perimeter of the construction Site.

.2 UV Facility structure and sampling building structures, both inside and outside. The pre-construction records will be compared to the post-construction records to assess damage or displacement of existing structures or equipment.

.3 Faulty Work.

.4 Type of excavation; width of trench, etc.

.5 Sheeting and shoring used.

.6 Dewatering methods, condition of bottom of excavation.

.7 Work on elements.

.7 A complete set of photographs shall be prepared by the Contractor and submitted to the Contract Administrator in two (2) electronic copies 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.

2. SUBMITTALS

2.1 Pre-construction Photographs

.1 Electronic on USB stick.

.2 Identification: date of exposure and location in upper right-hand corner.

.3 Minimum two hundred (200) photos to portray the condition of all buildings, roads, yards, and surface features related to the Work prior to the commencement of construction.

2.2 Construction Progress Photographs

.1 Electronic on USB stick.

.2 Identification: date of exposure in upper right-hand corner.

.3 Minimum forty (40) photographs per month. Locations to be as directed by the Contract Administrator.

.4 Frequency: monthly with progress claims.

2.3 Post-Construction Photographs

.1 Submit final photographs taken after the date of Total Performance, and no later than ten (10) Business Days after Total Performance.

.2 Electronic on USB stick.

.3 Identification: date of exposure in upper right hand corner.

.4 Minimum one hundred (100) photographs. Locations to be as directed by the Contract Administrator.

3. PRODUCTS

3.1 Photographs

.1 Photographs: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels.

.2 Digital Video Recordings: Provide high-resolution, digital video on USB.

END OF SECTION

SUBMITTAL PROCEDURES

1. GENERAL

1.1 Administrative

.1 Within the first eight (8) weeks of award, the Contractor shall provide signed letters (on company letterheads) from the manufacturers of the following equipment, confirming that the Shop Drawings process has commenced for this project:

.1 Valves.

.2 Piping.

.3 Motors.

.4 HVAC units.

.5 Roll-up doors.

.6 Monorails.

.7 Grout.

.8 Concrete.

.9 Coatings.

.10 Roofing.

.11 Ventilation units.

.12 Channel covers.

.13 Eye wash.

1.2 Description

.1 Submit to the Contract Administrator the submittals required by individual Specification sections for review. Submit promptly and in an orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Submit Shop Drawings for 90% of the value of all materials within the first ten (10) weeks of Notice to Proceed and then remainder Shop Drawings within eight (8) weeks afterwards.

.3 Do not proceed with Work affected by the submittal until reviewed by the Contract Administrator.

.4 Present Shop Drawings, product data, and samples in SI Metric units.

.1 Where items or information is not produced in SI Metric units, converted units 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 co-ordinated with requirements of Work and Contract Documents.

.6 The review by the Contract Administrator is for the sole purpose of ascertaining conformance with general concept. It does not provide 'approval' of the detail design inherent in Shop Drawings (which remains with the Contractor), nor does it relieve the Contractor of responsibility for errors or omissions in Shop Drawings or for meeting all requirements of the construction and Contract Documents.

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

.8 The Contractor shall make any corrections required by the Contract Administrator and shall resubmit the required number of corrected copies of submittals. The Contractor shall direct specific attention in writing on resubmitted submittals to revisions other than the corrections requested by the Contract Administrator on previous submission.

.9 After the Contract Administrator's review and return of copies, distribute copies to sub-trades as appropriate.

.10 Keep one (1) reviewed hard copy of each submission on Site filed by Division.

1.3 Submittal Procedures

.1 Direct submittals to the Contract Administrator.

.2 Hardcopy Submittals: Submit hard copies only where specifically required under individual Specifications sections.

.3 Electronic Submittals: Submittals made in electronic format shall be as follows:

.1 Each submittal shall be electronic file in Adobe Acrobat Portable Document Format (PDF), and native files (e.g. Word, Excel, AutoCAD, etc.). Use 2010 version or newer.

.2 Electronic files that contain more than ten (10) pages in PDF format shall contain internal book marking from index page to major sections of document.

.3 PDF files shall be set to open "Bookmarks and Page" view.

.4 Add general information to each PDF file, including title, subject, author, and keywords.

.5 PDF files shall be set up to print legibly at 215.9 mm by 279.4 mm (8.5" by 11"), 279.4 mm by 431.8 mm (11" by 17"), or ISO A1 (594 mm by 841 mm). No other paper sizes will be accepted.

.6 Submit new electronic files for each resubmittal.

.7 Include copy of transmittal of Contractor's submittal.

.8 Contract Administrator will reject submittals that are not accompanied by an electronic copy.

.9 Provide authorization for Contract Administrator to reproduce and distribute each file as many times as necessary for Project documentation.

.10 Detailed procedures for handling electronic submittals will be discussed at preconstruction meeting.

.11 Shop Drawings requiring an engineering seal shall be updated at project closeout and assigned a City of Winnipeg Water and Waste drawing number, sheet number, revision number and drawing size. Include fields in the Shop Drawing title block to incorporate the information.

.4 Schedule of Submittals:

.1 Prepare a table listing all anticipated submittals required to complete the Work.

.2 For each Specification Section show, at a minimum, the following:

.1 Specification Section.

.2 Total number of submittals for each Specification Section.

.3 Identify each submittal by its submittal number in accordance with a numbering and tracking system.

.4 Identify each submittal by its name or title.

.5 Identify the estimated date of submission to the Contract Administrator.

.6 State the revision number and status for each submittal.

.3 On a monthly basis, submit an updated schedule of submittals to the Contract Administrator if changes have occurred.

.5 Transmittal of Submittal:

.1 Stamp each submittal with uniform approval stamp before submitting to Contract Administrator.

.1 Stamp to include project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with Contract.

.2 Contract Administrator will not review submittals that do not bear Contractor's approval stamp and will return them without action.

.3 Contract Administrator will not review submittals received directly from a Subcontractor and will return them without action.

.4 Complete, sign, and transmit with each submittal package, one (1) transmittal of Contractor's submittal form.

.2 Identify each submittal with the following:

.1 Numbering and tracking system:

.1 Sequentially number each submittal.

.2 Resubmission of submittal shall have original number with sequential alphabetic suffix.

.2 Specification Section and paragraph to which submittal applies.

.3 Project title and City Tender number (**30-2025**).

.4 Date of transmittal.

.5 Name of Contractor.

.3 Include Contractor's written response to each of Contract Administrator's review comments with resubmission of submittals stamped "Exceptions Noted, Resubmit".

.6 Format:

.1 Do not base Shop Drawings on reproductions of Contract Documents.

.2 Package submittal information by individual Specification Section. Do not combine different Specification Sections together in submittal package, unless otherwise directed in Specification.

.3 Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract.

.4 Index with labeled tab dividers in orderly manner.

.7 Timeliness:

.1 Schedule and submit submittals in accordance with schedule of submittals and requirements of individual Specification Sections.

.2 Submit Shop Drawings and samples well in advance of scheduled delivery date for associated equipment or material and in an orderly sequence so as to cause no delay in the Work.

.8 Processing Time:

.1 Time for review shall commence on Contract Administrator's receipt of submittal.

.2 Contract Administrator will act upon Contractor's submittal and transmit response to Contractor not later than ten (10) Business Days after receipt, unless otherwise specified.

.3 Resubmittals will be subject to the same review time.

.4 The review time required will not alleviate the Contractor of his responsibility to deliver the completed Work within the required time frame and schedule. Planning for submittal

reviews and the risk to the construction schedule remains the Contractor's sole responsibility.

.9 Resubmittals:

.1 Clearly identify each correction or change made and include revision date.

.2 No adjustment of the schedule outlined in the Supplemental Conditions or Contract Price will be allowed due to delays in progress of Work caused by rejection and subsequent resubmittals.

.10 Incomplete Submittals:

.1 The Contract Administrator will return the entire submittal for the Contractor's revision if preliminary review deems it incomplete.

.2 Incomplete Shop Drawing information will be considered as stipulated deductions for the purposes of progress payment certificates.

.3 When any of the following are missing, the submittal will be deemed incomplete:

.1 Contractor's review stamp, completed and signed.

.2 Transmittal of Contractor's Submittal form, completed and signed.

.3 Insufficient number of copies.

.4 All requested information is not provided.

.5 Submittals missing Professional Engineer's seal and signature, where it is required.

.11 Submittals not required by Contract:

.1 Will not be reviewed and will be returned stamped "RECEIVED FOR INFORMATION".

.2 Contract Administrator will keep one (1) copy of all Shop Drawings and Product Data.

1.4 Shop Drawings and Product Data

.1 The term "Shop Drawing" as defined in the City's General Conditions for Construction (Revision 2020-01-31) means all drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Contractor, Subcontractor, manufacturer, supplier, or distributor and which illustrate some portion of the Work.

.2 In general, all equipment to be installed at the Site will require Shop Drawings, which shall be submitted to the Contract Administrator.

.3 Sales bulletins or other general publications are not acceptable as submittals for review except where necessary to provide supplemental technical data.

.4 Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract Price. If adjustments affect the value of the Work state such in writing to the Contract Administrator prior to proceeding with the Work. Failure to give such written notice

shall waive the Contractor's right to seek additional time or cost under the requirements of the Contract.

.5 All Shop Drawings are to include details as follows:

.1 Indicate dimensions, operating weights, materials, methods of construction, and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes, and other information necessary for completion of Work.

.2 Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross-references to Drawings and Specifications.

.3 Indicate clearances for operation, maintenance, and replacement of operating equipment devices.

.4 Include a markup specification section for each item, showing compliance with the spec with a checkmark and any deviations need to be explained.

.6 Electrical and instrumentation and control system Shop Drawings to include additional details as follows:

.1 Elevation layouts, bill of materials (BOM), fuse charts, schematics, interconnections, point-to-point wiring diagrams, loop wiring diagrams, motor control diagrams, single line diagram, 3-line diagram, and CSA/cUL panel plates in addition to the other wiring and detail requirements of the Contract.

.1 Panel plates shall be included in submissions, to be affixed on the front exterior door of the enclosure. They shall contain all information required under CSA C22.1 and C22.2. At a bare minimum the short circuit current rating (SCCR) of panel plates shall be equal to the MCC or Panelboard from which they are fed from.

.2 Wiring diagrams shall mark conductor identification, field terminals, changes, etc.

.3 Detailed listing of all nameplates.

.4 Identification in accordance with the City of Winnipeg Water & Waste Identification Standard (https://winnipeg.ca/waterandwaste/pdfs/dept/IdentificationStandard.pdf)

.2 Instrument Loop Diagrams (ILDs) – detailed drawings showing typical interconnections for the specified instrumentation and control devices. The Contractor is to reproduce an ILD for each device and record all relevant notes and installation-specific information on each sheet. Update the ILDs as necessary and fill in all terminal and wiring numbers, etc. from relevant Shop Drawings as they become available.

.1 Loop wiring diagrams shall follow ISA 5.4 for standard drawing layout, symbols, and wiring depictions.

.3 Motor Control Schematics (MCS) – when these are included, they are detailed drawings showing typical interconnections of motor control equipment. The Contractor is to reproduce a MCS for each motor and record all relevant notes and installation-specific information on each sheet. Update the MCS as necessary and fill in all terminal and wiring numbers, etc. from relevant Shop Drawings as they become available.

.4 Equipment descriptive data and detailed information for the system hardware and software (i.e., cutsheets or product literature). Failure to provide product literature or cutsheets with drawing submissions is grounds for marking the submission “Revise and Resubmit” without review.

.1 High-light only relevant information for the products provided. The intent of the literature is a technical review of the products suitability, technical ratings and limitations, and the installation/application. Do not include sales literature, or custom-made sheets, or sales declarations. Only manufacturer issued technical literature will be accepted.

.2 Where products have configurable part numbers, the part number options shall be broken down and either circled in red or highlighted in yellow.

.3 All cutsheets and product literature shall be provided showing CSA or cUL markings either circled in red or highlighted in yellow.

.4 Where hazardous location products are required, they shall also be submitted with their CSA or cUL certificates, and CSA or cUL required wiring diagrams for hazardous installations. The control system wiring diagrams shall capture these requirements, provide intrinsically safe barriers and methods as required, and provide notes for the electrical installer.

.5 Drawings for cabling:

.1 Provide Termination drawings with complete list of materials and nameplate engraving list.

.2 Provide Interconnection wiring diagrams for the complete system showing every fibre in each cable.

.6 Records of as-built information for the complete instrumentation and control system.

.1 Provide Enclosure/Cabinet temperature control calculations for heating and cooling loads. Appropriate temperature control shall be provided whenever required and maintain the enclosures CSA/NEMA rating.

.1 Temperature calculations shall be provided whenever Variable Frequency Drives (VFD), Variable Speed Drives (VSD), internally mounted transformers, or other components/devices may produce sufficient heat within the enclosure, or as requested by the Contract Administrator.

.7 Notify the Contract Administrator in writing of any deviations in Shop Drawings from the requirements of the Contract.

.1 Contract Administrator will not assume the responsibility for searching out deviations in the Contractor’s drawings.

.2 If works proceeds without notifying the Contract Administrator, the Contractor bears all responsibilities in regards to time and costs to rectify the issue at no cost to the City.

.8 Submit Shop Drawings stamped and signed by Professional Engineer registered or licensed in the Province of Manitoba as required in the Specifications. The following components require sealed Shop Drawings:

.1 Reinforcing steel.

.2 Metal fabrications.

.3 Pipe supports, hangers and anchors.

.9 The Contractor shall examine all Shop Drawings prior to submission to the Contract Administrator to ensure that all necessary requirements have been determined and verified and that each Shop Drawing has been checked and coordinated with the requirements of the Work and the Contract. Examination of each Shop Drawing shall be indicated by stamp, date, and signature of a responsible person of the Subcontractor for supplied items and of the Contractor for fabricated items. Shop Drawings not stamped, signed, and dated will be returned without being reviewed and stamped " REVISE AND RESUBMIT ". Ensure that the following are verified:

.1 Field measurements.

.2 Field construction criteria.

.3 Catalogue numbers and similar data.

.4 Coordination/confirmation between all Drawings and Specification.

.5 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Works. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of where they are specified or on which drawings the work appears. Indicate cross-references to Contract Drawings and Specifications.

.10 Submittals shall be in one (1) of the following formats:

.1 Submit three (3) copies of white prints and three (3) copies of all fixture cuts and brochures.

.2 Submit one (1) electronic PDF copy.

.11 Shop Drawings will be returned to the Contractor with one (1) of the following notations:

.1 When stamped "REVIEWED" or "NO EXCEPTIONS TAKEN", distribute additional copies as required for execution of the Work.

.2 When stamped "REVIEWED AS MODIFIED" or "MAKE NOTED CORRECTIONS", 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, as indicated, consistent with the Contract and submit again for review.

.4 When stamped "NOT REVIEWED" or "REJECTED", submit other Shop Drawings, brochures, etc., for review consistent with the Contract.

.5 Only Shop Drawings bearing "REVIEWED", "NO EXCEPTIONS TAKEN", "MAKE NOTED CORRECTIONS", or "REVIEWED AS MODIFIED" shall be used on the Work unless otherwise authorized by the Contract Administrator.

.12 After submittals are stamped "REVIEWED", "NO EXCEPTIONS TAKEN", "MAKE NOTED CORRECTIONS" or "REVIEWED AS MODIFIED", no further revisions are permitted unless re-submitted to the Contract Administrator for further review.

.13 Make changes in Shop Drawings, which the Contract Administrator may require, consistent with Contract. When re-submitting, notify the Contract Administrator in writing of any revisions other than those requested by the Contract Administrator.

.14 Only two (2) reviews of Shop Drawings will be made by the Contract Administrator at no cost. Each additional review will be charged to the Contractor at the Contract Administrator's scheduled rates. The Contract Administrator's charges for the additional Work will be deducted from the payment to the Contractor.

.15 All final reviewed Shop Drawings with red lines shall be drafted as original documents (CAD) with no red lines. These shall then be incorporated into the Operations and Maintenance Manuals.

1.5 Description of Construction Methods

.1 The Contractor shall, submit for the review of the Contract Administrator method statements which describe in detail, supplemented with Drawings where necessary, the methods to be adopted for executing any portion of Work.

.2 These statements shall also include details of constructional Plant and labour to be employed. Acceptance by the Contract Administrator shall not relieve the Contractor of any of his responsibilities, nor shall reasonable refusal to approve entitle the Contractor to extra payment or an extension of time.

.3 Other Considerations:

.1 Fabrication, erection, installation, or commissioning may require modifications to equipment or systems to conform to the design intent. Revise pertinent Shop Drawings and resubmit.

1.6 Requests for Information

.1 In the event that the Contractor or any Subcontractor involved in the Work, determines that some portion of the Drawings, Specifications, or other Contract documents requires clarification or interpretation by the Contract Administrator, the Contractor shall submit a Request for Information (RFI) Form in writing to the Contract Administrator.

.2 Submission Procedure:

.1 Submit RFI's to the Contract Administrator on the "Request for Information" form appended to this Section. The Contract Administrator shall not respond to a RFI except as submitted on this form. The link to the City's RFI form is provided below:

https://www.winnipeg.ca/infrastructure/templates/ExecutionControl/Request_for_Information_(RFI)_v2.0.docx

.2 Number RFI's consecutively in one sequence in order submitted, in a numbering system established by the Contract Administrator.

.3 Submit one (1) distinct subject per RFI request. Do not combine unrelated items on one (1) form.

.4 Where RFI form does not have sufficient space, attach additional sheets as required.

.5 Submit with RFI form all necessary supporting documentation.

.3 In the RFI, the Contractor shall clearly and concisely set forth:

.1 the issue for which clarification or interpretation is sought and why a response is needed from the Contract Administrator; and

.2 an interpretation or understanding of the requirement along with reasons why such an understanding was reached.

.4 The Contract Administrator will review all RFIs to determine whether they are valid RFIs. If it is determined that the document is not a valid RFI, it will be returned to the Contractor not having been reviewed with an explanation why it was deemed not valid.

.5 An RFI response shall be issued within ten (10) Business Days of receipt of the request from the Contractor unless the Contract Administrator determines that a longer time is necessary to provide an adequate response. When the RFI submission is received by the Contract Administrator before noon, the review period commences on that Business Day. When the RFI submission is received by the Contract Administrator after noon, the review period commences on the subsequent Business Day.

.6 If, at any time, the Contractor submits a large number of RFI's or the Contract Administrator considers the RFI to be of such complexity that the Contract Administrator cannot process the RFI's within ten (10) Business Days, the Contract Administrator shall confer with the Contractor within five (5) Business Days of receipt of such RFI's and the Contract Administrator and the Contractor will jointly prepare an estimate of the time necessary for processing same as well as an order of priority among the RFI's submitted. The Contractor shall accommodate such necessary time at no impact to the schedule and at no additional cost to the Contract.

.7 If the Contractor submits a RFI on an activity with ten (10) Business Days or less of available time to the impacted activity on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Contractor Administrator to respond to the request provided that the Contract Administrator responds within the ten (10) Business Days set forth above.

.8 An RFI response from the Contract Administrator will not change any requirement of the Contract. In the event the Contractor believes that the RFI response from the Contract Administrator will cause a change to the requirements of the Contract, the Contractor shall within ten (10) Business Days give written notice to the Contract Administrator stating that the Contractor believes the RFI response will result in a change to the Contract and the Contractor intends to submit a change request. Failure to give such written notice of ten (10) Business

Days shall waive the Contractor's right to seek additional time or cost under the requirements of the Contract.

1.7 Closeout Submittals

.1 Refer to Section 01 78 00 - Closeout Submittals for closeout submittal requirements.

1.8 Miscellaneous Submittals

.1 Prepare and submit submittals required Contract Documents.

.1 Submit manufacturer's instructions, printed product literature and data sheets for hazardous materials and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit hazardous materials management plan to Contract Administrator that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.

.3 Copies: Submit one (1) electronic copy to Contract Administrator. Method of electronic submission to be coordinated with Contract Administrator after execution of the Contract.

.1 Submit hard copies for paint samples and other submittals where specifically required under individual Specifications Sections.

.4 The Contract Administrator will review submittals for general conformance with design concept and intent, and general compliance with Contract.

.5 The Contract Administrator's review does not relieve Contractor from compliance with requirements of Contract nor from errors in submittals or Contractor's design.

.6 The Contractor is responsible for confirmation of dimensions at jobsite; fabrication processes; means, methods, techniques, sequences, and procedures of construction; coordination of work of all trades; and performance of Work in safe and satisfactory manner.

.7 At the Contract Administrator's option, the Contract Administrator's review comments and review stamp will be placed either directly on submitted copies of submittals or on separate submittal review comment form.

.8 Where work is to be designed by the Contractor, comply with applicable codes and furnish submittals signed and sealed by Professional Engineer licensed in Province of Manitoba, as required by Drawings. All calculations shall be submitted for review. Calculations shall also be signed and sealed by a Professional Engineer registered in the Province of Manitoba.

1.9 General Requirements for Submittals

.1 Details regarding submittals can be found in the individual Specification Sections.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

SUBMITTAL PROCEDURES

For details and instructions on how to complete this document, click the [¶] icon under the Home tab to display the hidden text.

RFI Title: _____ **RFI No.:** 0

Date RFI initiated: _____ **Date Response Requested by:** _____

Date Response Issued: _____

Project Name: _____

Submitted To:			
Contract Administrator (CA):		Consultant Ref. No.	
Company/Dept.:		Tender No.	

Requested By:		***For CA Use***	
Name:		City File No.:	
Title:		Project ID:	
Company:		Project Record Index No.:	
Email::		Purchase Order No.:	

Request/Question: (to be completed by Contractor)

Answer/Response: (to be completed by Contract Administrator)

Attachment(s):

Distribution (to be completed by Contract Administrator)

- Contract Administrator
- Contractor
- City Project Manager
- Other:

END OF SECTION

ENVIRONMENTAL PROTECTION

1. GENERAL

1.1 Section Includes

.1 Definitions:

.1 This Section specifies requirements for environmental controls including control of noise, dust, surface water and erosion, various pollution control methods and handling of Designated Substances as well as compliance with the Occupational Health and Safety Act and Site Safety.

.2 Reference Standards:

.1 U.S. Environmental Protection Agency (EPA)/Office of Water.

.2 EPA 832/R-92-005-92, Storm Water Management for Construction Activities, Chapter 3.

1.2 General

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

.2 Prior to commencing construction activities or delivery of materials to Site, provide Environmental Protection Plan for review by Contract Administrator.

.3 Ensure Environmental Protection Plan includes comprehensive overview of known or potential environmental issues to be addressed during construction.

.4 Address topics at level of detail commensurate with environmental issue and required construction task(s).

.5 Establish and maintain site procedures such that noise levels from construction areas are minimized.

.6 Control noise level in accordance with local by-laws.

.7 Prevent dust nuisance resulting from construction operations at all locations on the site and inside the filter tanks and piping gallery. Erect hoarding and tarp off the work area as necessary to prevent dust accumulation to working equipment. Erect tarps around the existing PAC panel, instrumentation and equipment as directed by the Contract Administrator.

.8 Protect existing services, land, vegetation, and water courses.

.9 No extra compensation will be paid for any dust or other control equipment and water supplied and applied on Saturdays, Sundays or holidays.

.10 Include in Environmental Protection Plan:

.1 Name(s) of person(s) responsible for ensuring adherence to Environmental Protection Plan.

.2 Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from Site.

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

.4 Descriptions of environmental protection personnel training program.

.5 Drawings showing locations of proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on Site.

.6 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Ensure plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff.

.7 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Ensure plan includes measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.

.8 Spill Control Plan including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.

.9 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.

.10 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on the project Site.

.11 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job Site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

.12 Waste Water Management Plan identifying methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.

.13 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.

1.3 Measures

.1 Noise Control:

.1 Use vehicles and equipment with efficient muffling devices.

.2 Provide and use devices that will minimize noise levels in construction areas.

.2 Dust Controls:

.1 Dust shall be controlled through wetting down with water and power sweeping or by the construction of temporary access routes using Engineered materials (i.e., Granular “A” and Granular “B”).

.2 Transport dusty materials in covered haulage vehicles.

.3 Use of calcium chloride shall not be allowed for the control of dust.

.3 Mud Control:

.1 Keep facility roads and public roadways clean and free from mud.

.2 Provide mud mats and/or wash stations to prevent tracking of mud from any portion of the contract limits onto any paved roadway.

.3 Clean station access road from the main gate to the two circular roads on the north and south side of the UV Building. The street sweeper should be capable of wet and dry cleaning. Ensure that dust is controlled during cleaning operations.

.4 Obtain and pay for services of street sweeper weekly until Substantial Performance Date. This activity shall not be terminated at anytime during this period unless directed by the Contract Administrator.

.4 Surface Water and Dewatering Control:

.1 Control all surface water and groundwater including rainfall, run-off, seepage from cofferdams and diversion channels, ice and snow. Ensure that erosion is controlled and that flooding of excavations or damage to structures does not occur.

.2 Intercept and divert surface drainage away from excavations and any groundwater monitoring devices where used. Intercept surface drainage as far back from excavations as practical by means of ditches, berms or other interception methods as may be required for effective control.

.3 Direct pumped water or run-off to settling ponds or sediment basins prior to discharge to adjacent storm sewers or watercourses.

.4 Provide settling ponds and sediment basins where needed.

.1 Control overflow rates from settling ponds or sediment basins to ensure minimum solids transportation.

.2 Provide straw bales, filter berms or sand bags as required to retard and filter run-off prior to discharge to storm sewers or watercourses.

.5 Intercept and divert concentrated run-off from unstable areas under sheet flow conditions, as directed by the Contract Administrator.

.6 Do not direct any flow of water across or over pavements, except through approved pipes or properly constructed troughs.

.7 Keep gutters and drainage ditches open at all times to provide adequate surface drainage.

.8 Maintain all existing storm sewers clean and free of deleterious materials and blockages.

.9 Provide splash pads where water is discharged to the watercourse.

.10 Dispose of water so as not to be injurious to public health or safety, to property or to any part of work completed or under construction.

.11 Provide staked silt fence as required.

1.4 Refueling Areas

.1 Review all proposed construction areas to plan access routes and fuelling areas.

.2 Establish suitable fuelling and maintenance areas and obtain approval from the Contract Administrator.

.3 Do not fuel equipment within 30 m of any watercourse unless otherwise non-spill facilities are used.

1.5 Cleaning Equipment

.1 Clean construction equipment prior to entering any paved roadway. At a minimum, all construction equipment should be cleaned weekly.

.2 Do not clean equipment in locations where debris can gain access to sewers, watercourses or aquifers.

1.6 Spills

.1 Submit procedures for interception, rapid clean-up and disposal of any spillage that may occur, for the Contract Administrator’s review, prior to commencing Work.

.2 Be prepared at all times to intercept, clean-up and dispose of any spillage that may occur whether on land or water.

.3 Keep all materials required for clean up of spillages readily accessible on Site.

.4 Report immediately any spills causing damage to the environment to the MOECC Spills Centre, the City’s Sewer Use Group and the Contract Administrator.

1.7 Use of Pesticides

.1 Coordinate the use of herbicides, pesticides and fungicides with landowners and occupants and Regional Pesticides Control Office and obtain all necessary approvals prior to use.

.2 Obtain approval prior to using any herbicides, pesticides and fungicides within an aquifer protection area.

1.8 Management and Disposal of Excess Materials

.1 Obtain waiver from landfill site releasing the City from any liabilities, responsibilities with respect to the disposal of any type of material at the site. The Contractor shall exercise extreme caution during the excavation, collection, transport and disposal at landfill site of all excess and unsuitable materials.

1.9 Compliance with the Occupational Health and Safety Act

.1 It is specifically drawn to the attention of the Contractor that the Occupational Health and Safety Act provides, in addition to other items that:

.1 A Constructor shall ensure, on a project undertaken by the Contractor that:

.1 The measures and procedures prescribed by this Act and Regulations are carried out on the project.

.2 Every employer and every worker performing work on the project complies with this Act and the regulations.

.3 The health and safety of workers on the project is protected.

.4 This Contract is deemed to be an individual project for the purposes of the Occupational Health and Safety Act and the regulations made thereunder and the Contractor to whom the Contract is awarded unequivocally acknowledges that he is the Constructor as defined in the said Act on this project and shall carry out all of the obligations and shall bear all of the responsibilities of the Constructor as set out in the said Act and Regulations.

.5 If the City is designated as the “Constructor” as a result of the Contractor’s actions, any increases in the Contractor’s or the City’s costs shall be borne by the Contractor.

.6 All Occupational Health and Safety Act Regulations for construction projects are to be strictly adhered to.

.7 The Contractor shall submit a work safety plan detailing safety precautions to be implemented during completion of this Contract. The items detailed shall include, as a minimum:

.1 Excavation, shoring, backfill, dewatering.

.2 Pipes, valves, equipment installations.

.3 Concrete formwork, re-steel, pouring.

.4 Electrical installations, etc.

1.10 Historical/Archaeological Control

.1 Provide historical, archaeological, cultural resources plan that defines procedures for identifying procedures to be followed if historical archaeological, and cultural resources not previously known to be on Site or in the area are discovered during construction.

.2 Plan: include methods to assure protection of known or discovered resources and identify lines of communication between Contractor personnel and the Contract Administrator.

1.11 Fires

.1 Fires and burning of rubbish on the Site is not permitted.

1.12 Notification

.1 The Contract Administrator will notify the Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.

.2 The Contractor after receipt of such notice will inform the Contract Administrator of proposed corrective action.

.3 Do not take action until after receipt of written approval by Contract Administrator.

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

.5 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Cleaning

.1 Clean in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

MEASUREMENT AND PAYMENT

1. GENERAL

1.1 References

.1 City of Winnipeg / Contractor Agreement.

1.2 General

.1 In addition to covering the cost of various items of Work for which the Contract Unit Prices and Contract Lump Sum Prices are set forth in the Contract, the Contract Prices so set forth shall be held to cover and shall cover the cost of furnishing all materials, plant, tools, equipment, labour, services, transportation and incidentals necessary for executing the Work required of the Contractor under the terms of the Contract, Plans and Specifications, and the observing, performing and keeping of all the terms, covenants and conditions of the Contract all of which shall be observed, performed and kept by the Contractor. 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.

1.3 Schedule of Values

.1 Provide Schedule of Values for lump sum items for itemized evaluation of payment estimates. Schedule is to be supported by evidence as Contract Administrator may reasonably request. Once accepted by the Contract Administrator, the Schedule of Values will be used as background basis for applications for payment.

.2 Include statement based on Schedule of Values with each application for payment.

1.4 Measurement and Payment

.1 Payment for Work performed under the various Divisions of the Construction Contract shall be made at the respective Lump Sum Price or Unit Price for that item as indicated.

.2 General Conditions:

.1 Measurement for “General Conditions” will be based on the percentage of dollar value of Work completed vs. the total Contract price.

.2 Payment for General Conditions shall be lump sum as specified in the contract unit price for “General Conditions”. Insurance and bonding, loading assembly, transporting and setting up of the Contractor’s equipment, additional facilities, tools, supplies, demobilization when the project is complete, and all other such works shall be considered incidental. General Conditions shall include Division 1.

.3 Civil and Site Works:

.1 Existing road repair, new road and construction of the yard piping will be measured on a lump sum basis. The Work shall include:

.1 Road Works related to the supply and installation of the access road, tie into existing road, expansion and repair of the existing road, embankments for built up areas and other Site improvements as required in the Specifications including fill material, geogrid, and granular material. This includes miscellaneous demolition required for pipe replacement and road reconstruction or expansion.

.2 Placing of Topsoil and Seeding.

.3 All erosion control works as needed for environmental protection and as detailed in these specifications are considered incidental to this item.

.4 Yard piping from 1 m outside of the UV Building including various pipes and a 600 mm future use pipe for flushing water.

.5 Excavation of existing material from pavement areas.

.6 Sub-grade Compaction in accordance with City of Winnipeg Standard Construction Specification CW 3110.

.7 Placement and compaction of fill material in accordance with City of Winnipeg Standard Construction Specification CW 3170 for Suitable Site Fill Material and Imported Fill Material.

.8 Placement and compaction of sub-base course material in accordance with City of Winnipeg Standard Construction Specification CW 3110 for Crushed Sub-Base Material, 50 mm Granular A.

.9 Placement and compaction of Base course material will be in accordance with City of Winnipeg Standard Construction Specification CW 3110.

.10 Construction of asphaltic concrete pavement and overlays in accordance with City of Winnipeg Standard Construction Specification CW 3410.

.11 Construction of Portland concrete pavement in accordance with City of Winnipeg Standard Construction Specification CW 3310 for the applicable thickness and type of pavement constructed.

.12 Installation of drilled dowels and tie bars in accordance with City of Winnipeg Standard Construction Specification CW 3230 for the applicable diameter and type of dowel or tie bar installed.

.13 Construction of concrete curb, curb and gutter and gutter in accordance with City of Winnipeg Standard Construction Specification CW 3310.

.14 Construction of concrete sidewalk in accordance with City of Winnipeg Standard Construction Specification CW 3310.

.2 Basis of Payment: The lump sum price shall include all labour, equipment, and material for the completion of the Civil and Site Works according to the Drawings and Specifications. Civil and Site Works shall include but is not limited to the Works defined in Divisions 32 and 33 of these Specifications.

.4 UV Facility Storage Room Superstructure:

.1 Method of Measurement: Complete construction of the UV Facility Storage Room superstructure Work will be measured on a lump sum basis. The superstructure shall include all works performed above grade for the storage room, these include but are not limited to the building, walls, roof and all other miscellaneous items required to achieve compliance with Drawings and Specifications.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all labour, equipment, and material for the completion of the superstructure according to the Drawings and Specifications. Superstructure works shall include but is not limited to the Works defined in Divisions 2, 3, 4, 5, 6, 7, 8, 9, and 10.

.5 UV Facility Storage Room Substructure:

.1 Method of Measurement: Complete construction of the Storage Room Substructure will be measured on a lump sum basis. The substructure shall include all Works performed below grade, including but not limited to excavation, backfill, concrete works, supply and installation of precast piles, supply and installation of precast pile tips, splicing of piles and all other miscellaneous items required to achieve compliance with Drawings and Specifications.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all labour, equipment, and material for the completion of the substructure according to the Drawings and Specifications. Substructure Works shall include but is not limited to the Works defined in Divisions 3, 6, 7, 9 and 31.

.6 Existing UV Building Roofing Replacement:

.1 Method of Measurement: Removal of existing roofing materials for demolition and replacement shall be measured on a lump sum basis.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all labour, equipment, and material for the completion of the roofing demolition and replacement Works. Roofing is defined in Division 7.

.7 Demolition:

.1 Method of Measurement: Demolition works include all disciplines except for reroofing of the existing UV Facility and miscellaneous demolition required for installation of road Works.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all labour, equipment, and material. Demolition is defined in Division 2.

.8 Process Works (Complete Project):

.1 Method of Measurement: Measurement for Process Works as shown on the plans and described in the Specifications shall be on a lump sum basis. Work includes pumps, process and mechanical equipment, upstream and downstream gates, spray nozzles, UV equipment, bulkheads for UV isolation, access hatch, three (3) monorails over channels, access points for exterior ventilation, access point for a future use 600 mm gravity pipe, chemical dosing systems, pressure testing, valves and piping, and all associated Work. This includes miscellaneous relocation of lights, electrical or other items as required.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all labour, equipment and material for the completion of the Process Work according to the Drawings and Specifications. Process Works includes but is not limited to the works defined in Divisions 40, 46 and items supplied in Appendix H for gates, and Appendix B for UV equipment.

.9 Mechanical Works (Complete Project):

.1 Method of Measurement: Measurement for Mechanical Works as shown on the plans and described in the Specifications shall be on a lump sum basis. Work includes all mechanical systems for the existing UV Facility, the new UV Storage building and the external ventilation. This will include heating, plumbing, air distribution, air blowers, air conditioning and all associated Work.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related Works. The price shall include all labour, equipment and material for the completion of the Mechanical Work according to the Drawings and Specifications. All Works related to mechanical systems and all associated components, shall be incidental to the Works. Mechanical Works shall include but is not limited to the Works defined in Divisions 22 and 23.

.10 UV Facility Electrical and Controls Supply and Installation:

.1 Method of Measurement: Measurement for UV Facility Electrical and Instrumentation & Controls as shown on the plans and described in the Specifications shall be on a lump sum basis. Work includes electrical equipment systems, necessary electrical movements, fire alarms, door openers, ventilation, instrumentation and control systems and all associated Work. Costs excludes supply of transformers (and installation), Motor Control Centers and UV systems supplied by the City, but it does include installation.

.2 Basis of Payment: Electrical and instrumentation and control shall include electrical Work, instrumentation and controls, SCADA systems, computer systems, and coordination for electrical power supply on a lump sum basis. This includes installation. Permit costs are paid as a separate line item. Divisions 26 and 28.

.11 Transformer Installation During Bypass Period:

.1 Method of Measurement: Measurement for installation of two (2) - 4160:480Volt and two (2) - 4160:600Volt units as shown on the plans and described in the Specifications shall be on a lump sum basis. The contractor shall provide detailed pricing for the Transformer Installation as described for Base Bid in Appendix K. Work includes installation of transformers and all associated Work.

.2 Basis of Payment: Installation of transformers shall include all electrical Work, and coordination for electrical power supply on a lump sum basis, based on the detailed pricing provided by the Contractor. Permit costs are paid as a separate line item. Divisions 26, 28 and 40. Appendix K provides a detailed description of the transformer installation.

.12 Commissioning, Demonstration and Training:

.1 Method of Measurement: Measurement for Commissioning, Demonstration and Training as described in the UV Facility specifications shall be on a lump sum basis. Work includes acceptance, equipment delivery, equipment installation training, equipment installation, and equipment performance testing and commissioning for all equipment and all associated Work.

.2 Unless otherwise noted all testing is the responsibility of the Contractor and shall be considered incidental to this item. Any water or other resources required for testing are the responsibility of the Contractor.

.3 Basis of Payment: Payment shall be based on a lump sum basis for all related Works. The price shall include all labour, equipment and material for the completion of the Commissioning, Demonstration and Training according to the Specifications for new and related existing equipment. All Works related to start-up, commissioning, training, equipment installation, shall be incidental to the Works. Commissioning, Demonstration and Training shall include but is not limited to the Works defined in Division 1. It also includes City purchased items in the Appendices B, C, D, and H for UV Systems, Transformers, Gates and Motor Control Centres.

.13 Closeout Submittals:

.1 Method of Measurement: Measurement for Closeout Submittal as described in the Specifications shall be on a lump sum basis. Work includes hard and electronic copies of Operating and Maintenance Manuals for all pieces of equipment or material that are contained within Specifications and all associated Work, red line drawings and final survey.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related Works. The price shall include all labour, equipment and material for the completion of the O&M Manuals, red line drawings and final survey according to the Drawings and Specifications. All Works related to hard and digital copies of O&M Manuals, red line drawings and final survey shall be incidental to the Works. Closeout Submittals shall include but is not limited to the Works defined in Section 01 78 00 - Closeout Submittals.

.14 Building Permit:

.1 Method of Measurement: Measurement for the building permit will be on a lump sum basis.

.2 Basis of Payment: Work shall include procuring and submitting the building permit at the established price as detailed in the Schedule of Prices. Permit is to include all components including City purchased items in Appendices B, C, D, and H.

.15 Cash Allowance #1 - Temporary Reuse of Existing Transformers and Sequential Installation of New Transformers:

.1 Method of Measurement: The Contractor shall provide a detailed cost estimate for all additional work as requested by the City.

.2 Payment for Extra Work shall only be incorporated into the Construction Contract with approval from the City and the Contract Administrator.

.1 Cash Allowance #1 includes allowance for temporary connection of the new motor control centres to the existing transformers and sequential installation of the new transformers. Divisions 26, 28 and 40. Appendix K provides a detailed description of the temporary reuse of the existing transformers and sequential transformer installation. Cash Allowance #1 only includes additional work over and above the costs associated with the base bid described in Clause 1.4.11, as described in Appendix K.

.3 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all labour, equipment, and material for the proposed works.

.16 Cash Allowance #2 – Various Works:

.1 Method of Measurement: The Contractor shall provide a detailed cost estimate for all additional work as requested by the City.

.2 Payment for Extra Work shall only be incorporated into the Construction Contract with approval the City and the Contract Administrator.

.3 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all labour, equipment, and material for the proposed works.

1.5 Items Covered by Contract Prices

.1 Construction Contract Prices:

.2 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, plant, 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.

1.6 Interim Completion of Works During 4 Month UV Bypass Period

.1 Completion and start-up of two UV channels and restarting disinfection by the end of 4-month shutdown period is essential to achieve interim completion of the UV System. Liquidated damages will be applied daily until the system is functional beyond the four month period.

1.7 Substantial Performance of Work

.1 Submit Final Operation and Maintenance Manuals as per Section 01 78 00, complete with all required commissioning reports. Final Operation and Maintenance Manuals approved by the Contract Administrator and complete with all required commissioning reports are required prior to Substantial Performance.

.2 Completed As-Built Drawings are required prior to Substantial Performance.

.3 Prepare and submit to the Contract Administrator a comprehensive list of items to be completed or corrected and apply for a review by the Contract Administrator to establish Substantial Performance of Work or substantial performance of designated portion of Work when Work is substantially performed if permitted by lien legislation applicable to Place of Work designated portion which the City agrees to accept separately is substantially performed. Failure to include items on list does not alter responsibility to complete Construction Contract.

.4 No later than ten (10) days after receipt of list and application, The Contract Administrator will review the Work to verify the validity of the application, and no later than seven (7) days after completing the review, will notify the Construction Contractor if the Work or designated portion of the Work is substantially performed.

.5 The Contract Administrator will state the date of Substantial Performance of Work or designated portion of the Work in certificate.

.6 Immediately following the issuance of certificate of Substantial Performance of Work, in consultation with the Contract Administrator, will establish a reasonable date for finishing Work.

1.8 Payment of Holdback Upon Substantial Performance of Work

.1 After issuance of certificate of Substantial Performance of Work:

.1 Submit application for payment of holdback amount.

.2 Submit sworn statement that accounts for labour, subcontracts, products, construction machinery and equipment, and other indebtedness which may have been incurred in Substantial Performance of Work and for which the City might be held responsible have been paid in full, except for amounts properly retained as holdback or as identified amount in dispute.

.2 After receipt of application for payment and sworn statement, Contract Administrator will issue certificate for payment of holdback amount.

.3 Where holdback amount has not been placed in a separate holdback account, the City shall, ten (10) days prior to expiry of the holdback period stipulated in lien legislation applicable to Place of Work, place the holdback amount in a bank account in joint names of the City and Contractor.

.4 The amount authorized by certificate for payment of holdback amount is due and payable on the next Wednesday following the expiration of the holdback period stipulated in lien legislation applicable to Place of Work. Where lien legislation does not exist or apply, the holdback amount is due and payable in accordance with other legislation, industry practice, or provisions which may be agreed to between parties. The City may retain, out of the holdback amount, sums required by law to satisfy liens against Work or, if permitted by lien legislation applicable to Place of Work, other third party monetary claims against the Contractor which are enforceable against the City.

1.9 Final Payment

.1 Submit application for final payment when the Work is completed.

.2 The Contract Administrator will, no later than ten (10) days after receipt of application for final payment, review Work to verify validity of application. The Contract Administrator will give notification that the application is valid or give reasons why it is not valid, no later than seven (7) days after reviewing Work.

.3 The Contract Administrator will issue final certificate for payment when application for final payment is found valid.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

REGULATORY REQUIREMENTS

1. GENERAL

1.1 Permits/Inspections

.1 Arrange and pay for the regulatory submittals and inspections necessary for the completion of the Work in accordance with Federal, Provincial, and District laws, regulations, and by-laws.

.2 Within one (1) week of receipt, provide one (1) copy of all regulatory reports, permits, and other documents to the Contract Administrator. Include any reports related to Contractor operations on the Site.

.3 The Contractor shall send Electrical Drawings to Manitoba Hydro with confirmation of acceptance within three (3) weeks of Contract Award.

1.2 References and Codes

.1 Conform to all Federal, Provincial, and District Codes, regulations and by-laws.

.2 Perform Work in accordance with the National Building Code of Canada (NBC) including amendments up to the tender closing date and other codes of provincial or local application provided so that in case of conflict or discrepancy, the more stringent requirements apply.

.3 Meet or exceed requirements of:

.1 Construction Contract Documents.

.2 Specified standards, codes and referenced documents.

.4 In the event of discrepancies between codes, standards or other provisions, the most stringent shall apply.

1.3 Building Smoking Environment

.1 Comply with smoking restrictions and municipal by-laws.

1.4 Visitors

.1 Make available four (4) “visitor” safety helmets, four (4) safety glasses and four (4) vests for authorized visitors.

.2 Ensure that visitors are provided safety orientation.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 References

.1 Within the text of the Specifications, reference may be made to the following standards:

.1	ACI	American Concrete Institute
.2	AISC	American Institute of Steel Construction
.3	ANSI	American National Standards Institute
.4	ASTM	American Society for Testing and Materials
.5	AWWA	American Water Works Association
.6	CANI	National Standard of Canada
.7	CEC	Canadian Electric Code (published by CSA)
.8	CGA	Canadian Gas Association
.9	CGSB	Canadian Government Specification Board
.10	CISC	Canadian Institute of Steel Construction
.11	CLA	Canadian Lumberman's Association
.12	CPCA	Canadian Printing Contractors Association
.13	CPCI	Canadian Pre-stressed Concrete Institute
.14	CRCA	Canadian Roofing Construction Association
.15	CSA	Canadian Standards Association
.16	DIN	Deutsches Institut Normung
.17	EEMAC	Electrical and Electronic Manufacturer's Association of Canada
.18	EIB	Electrical Inspection Branch
.19	FMEC	Factory Manual Engineering Corporation
.20	IEEE	Institute of Electrical and Electronic Engineers
.21	IPCEA	Insulated Power Cable Engineers Association
.22	NAAMM	National Association of Architectural Metal Manufacturers
.23	NACE	National Association of Corrosion Engineers

.24 NBC National Building Code

.25 NEMA National Electric Manufacturers Association

.26 NFPA National Fire Protection Association

.27 ULC Underwriters Laboratories of Canada

.2 Conform to the latest version of such standards available at the time of tendering, in whole or in part, as specified.

.3 If there are questions as to whether any product or system is in conformance with applicable standards, the Contract Administrator reserves the right to have such products or systems tested to prove or disprove conformance with Construction Contract Documents, or by the Contractor in the event of non-conformance.

1.2 Inspection

.1 Allow the Contract Administrator access to the Work. If part of the Work is in preparation at locations other than the Place of Work, allow access to such Work whenever it is in progress.

.2 Give minimum seventy-two (72) hours notice when requesting inspection if the Work is designated for special tests, inspections or approvals by the Contract Administrator, or law of Place of Work.

.3 If the Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work at no cost to the City.

.4 The Contract Administrator will order part of the Work to be examined if Work is suspected to be not in accordance with the Construction Contract Documents. If, upon examination such Work is found not in accordance with the Construction Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with the Construction Contract Documents, the City shall pay cost of examination.

1.3 Independent Inspection Agencies

.1 Where inspecting, testing and similar quality control services are specifically indicated in the Specification Sections as the Contractor's responsibility, the Contractor shall engage appropriate Independent Inspection/Testing Agencies. The cost of such services will be borne by the Contractor.

.2 The City may elect to engage Independent Inspection/Testing Agencies for the purpose of quality assurance inspecting and/or testing portions of the Work. The cost of such services will be borne by the City.

.3 Where the City has engaged an Inspection/Testing Agency for testing and inspection of a part of the Work and the Contractor is also required to engage an Inspection/Testing Agency for the same or related part of the Work; the Contractor shall not employ the same agency engaged by the City without the prior written approval of the City.

.4 All equipment required for carrying out the above inspection and testing will be provided by the appointed agencies.

.5 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Construction Contract Documents.

.6 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain the full degree of defect. Correct the defect and irregularities as advised by the City at no cost to the City. Pay costs for retesting and re-inspection.

1.4 Access to Work

.1 Allow inspection/testing agencies access to Work, off Site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

1.5 Procedures

.1 Notify appropriate agency and the Contract Administrator in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in the Specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on Site. Provide sufficient space to store and cure test samples.

1.6 Rejected Work

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

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

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

1.7 Reports

.1 Submit one (1) electronic copy of inspection and test reports to the Contract Administrator.

.2 Provide copies to the Subcontractor of work being inspected or tested and to the manufacturer or fabricator of material being inspected or tested.

.3 Each report shall include:

.1 Date of issue.

.2 Construction Contract name and number.

.3 Name, address and telephone number of Inspection/Testing Agency.

.4 Name and signature of inspector and tester.

.5 Date of inspection or test.

.6 Identification of the Product and Specification Section covering inspected or tested Work.

.7 Location of the inspection or the location from which the tested product was derived.

.8 Type of inspection or test.

.9 Complete inspection or test data.

.10 Test results and an interpretation of test results.

.11 Ambient conditions at the time of sample taking and testing.

.12 The remarks and observations on compliance with the Construction Contract Documents.

.13 Recommendations on retesting or other corrective action where necessary.

.14 Signature of a qualified and authorized representative of the Agency.

.4 Submit reports within forty-eight (48) hours; notwithstanding, notify the Contract Administrator immediately if the test indicates improper conditions or procedures.

.5 Refer to Specification section for definitive requirements.

1.8 Tests and Mix Designs

.1 Furnish test results and mix designs as requested.

.2 Cost of tests and mix designs beyond those called for in the Construction Contract Documents or beyond those required by-law of Place of Work will be appraised by the Contract Administrator and may be authorized as recoverable.

1.9 Mill Tests

.1 Submit mill test certificates as requested or as required.

1.10 Equipment and Systems

.1 Submit adjustment and balancing reports for process, mechanical, electrical and building equipment systems as indicated in Section 01 33 00.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

TEMPORARY UTILITIES

1. GENERAL

1.1 Action and Informational Submittals

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

1.2 Installation and Removal

.1 Provide temporary utilities controls in order to execute Work expeditiously.

.2 Remove from Site all such work after use.

.3 Utilities shall be maintained for the UV Building during construction as well as the Effluent Sample building.

1.3 Water Supply

.1 The Contractor shall use potable water.

.2 All water is to be obtained and paid for by the Contractor. If a tie-in to the City service is allowed, install backflow preventer. All water will be metered and priced back to the Contractor.

1.4 Wastewater Collection

.1 The Contractor will not have a temporary service for wastewater at Site. This must be collected and hauled by a licenced hauler.

1.5 Temporary Heating and Ventilation

.1 Provide temporary heating required during the construction period, including attendance, maintenance and fuel.

.2 Construction heaters used inside buildings must be vented to outside or be the non-flame 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.

.4 Temporary heating apparatus shall be installed and operated in such manner that finished work and existing building systems will not be damaged thereby.

.5 Maintain temperatures of minimum 10°C in areas where construction is in progress.

.6 Ventilating:

.1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.

.2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into the atmosphere of occupied areas.

.3 Dispose of exhaust materials in a 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.

.7 Permanent heating system of building, to be used when available. Be responsible for damage to heating system if use is available. Power and gas costs to be paid for by the Contractor.

.1 During the shutdown period, permanent heating system will not be available. The Contractor shall provide and install suitable temporary heating apparatus provide adequate and proper fuel and shall maintain the building temperature at a minimum of 10°C when the UV Building's permanent heating system is offline. Costs for temporary heating shall be borne by the Contractor.

.8 On completion of Work for which permanent heating system is used, calibrate and service the HVAC system, replace filters, clean and return to a like new state.

.9 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 the outside.

.10 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.6 Temporary Power and Light

.1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools.

.1 City of Winnipeg will provide a 600V, 25A (80%) supplemental source from existing MCC M, located at the Administration building electrical room. Contractor will provide and run temporary cabling from MCC source for construction power, cabling will be laid around the existing construction zone. Restore room to as found state after completion of Work. Cabling will be laid outside and protected from mechanical damaged, see CEC section 76.

.2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.

.3 Provide and maintain temporary lighting throughout the Project. Ensure level of illumination on all floors and stairs is not less than 162 lux.

.4 Electrical power and lighting systems installed under this Construction Contract may be used for construction requirements only with prior approval of the Contract Administrator provided that guarantees are not affected. Make good damage to electrical system caused by use under this Construction Contract. Replace lamps which have been used for more than three (3) months.

.5 During utility power outage at the UV building, Contractor will maintain power to Effluent Sampling building by providing temporary cabling and accessories from Main building panel tagged as “208/108V DISTRIBUTION PANEL,” using the 40A breaker labelled “Spare.” Connect to Effluent Sampling building Panel C, size cabling to cable length (Contractor to confirm) and building load. Cabling will be laid outside and protected from mechanical damaged, see CEC section 76. Restore to as-found state after the removal of temporary cabling. If wall coring is required, Contractor will provide Asbestos testing and remediation services. Avoid running cabling through existing construction designated areas.

1.7 Fire Protection

.1 Provide and maintain temporary fire protection equipment and access for fire fighters during performance of the Work required by the insurance companies having jurisdiction and governing codes, regulations and by-laws.

.2 Burning rubbish and construction waste materials is not permitted on Site.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CONSTRUCTION FACILITIES

1. GENERAL

1.1 References

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.

.2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.2 Canadian Standards Association (CSA International):

.1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA-0121-M1978(R2003), Douglas Fir Plywood.

.3 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.

.4 CAN/CSA-Z321-96(R2001), Signs and Symbols for the Occupational Environment.

1.2 Action and Informational Submittals

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

1.3 Installation and Removal

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

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

.3 Indicate use of supplemental or other staging area.

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

.5 Remove from Site all such Work after use.

1.4 Scaffolding

.1 Scaffolding in accordance with CAN/CSA-S269.2.

.2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms, temporary stairs and all other construction items necessary to complete the Work.

1.5 Hoisting

.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 Hoists and cranes to be operated by qualified operator.

1.6 Site Storage/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.

1.7 Construction Parking

.1 Parking will be permitted on Site in an area as directed by the Contract Administrator provided it does not disrupt performance of the Work or operation of the existing treatment facilities.

.2 Provide and maintain adequate access to Project Site.

1.8 Security

.1 Maintain a secure Site, with fencing around the Contractors work area.

1.9 Offices

.1 Provide a trailer with shared access for the Contract Administrator, the City, and the Contractor as specified.

.1 Supply and maintain two (2) offices in a trailer, satisfactory to the Contract Administrator and City, for the exclusive use of the Contract Administrator and City for the duration of the Contract until at least three (3) months following Substantial Performance.

.2 Trailer to consist of a minimum of the following rooms inside the trailer:

.1 Office for City with own door with lock and key.

.2 Office for Contract Administrator with own door with lock and key.

.3 Meeting Room to fit a minimum of eight (8) chairs and persons for contract meetings.

.4 Kitchenette.

.5 Washroom (shared for trailer),

.6 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.

.3 Locate the trailer within the work area as directed by the Contract Administrator, physically separated from any other structure.

.4 Make all necessary applications, obtain permits and pay for all fees, charges for service and use.

.5 Provide and pay for all temporary telephone, potable water, power, heating, air-conditioning, high-speed internet equipment and services and lighting required during construction.

.6 Provide a windproof, weather tight structure at least 300 mm above ground level and having a floor area of not less than 50 m^2 and 2.6 m ceiling height.

.7 Equip each 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) legal-size, 4 drawer file cabinet with lock and key.

.4 One (1), three tier wooden bookcase.

.5 Unlimited high speed internet connection. including Wi-Fi internet service.

.6 One (1) wastepaper basket.

.8 Equip meeting room with:

.1 A 3.0 m x 1.25 m meeting table.

.2 Eight (8) standard office chairs.

.3 Fire extinguisher and first aid kit.

.4 Whiteboard with two (2) sets of markers.

.5 One (1) wastepaper basket.

.9 Equip kitchen with:

.1 One (1) combination hot and cold water cooler.

.2 One (1) standard refrigerator, minimum 0.5 m^3 (18 ft^3).

.3 One (1) standard microwave.

.4 One (1) hot and cold water sink with dishwashing soap and rags.

.5 Cabinetry with drawers to store napkins, paper towels, dishes and cutlery along with a minimum set of six (6) plates, cups, knives, forks and spoons.

.6 One (1) waste basket.

.10 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 each office, storage room and meeting room (4 minimum) as required.

.11 Provide doors to the trailer and to each office with suitable locks. Main door to the trailer shall come with at least eight (8) sets of keys.

.12 Provide at least two (2) windows within the meeting room and one (1) window within each office and the kitchen, 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.

.13 Provide washroom facilities with hot and cold sink, toilet, waste basket and mirror for shared use by the Contract Administrator and the City and other trailer occupants. Maintain a supply of paper towels, toilet paper, and soap throughout the duration of the project.

.14 Provide weekly janitorial services and all washroom supplies.

.15 Provide heat tracing to prevent freezing of pipes when not in use.

.16 Provide one (1) printer/copier/scanner multi-function machine to meet the following specifications:

.1 Required functions-black and white 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 Scanner type – flattened.

.11 Scanner resolution - up to 600 dpi with scan resolution software.

.12 Task speed - 5.6 seconds, 600 x 600 dpi.

.13 Maximum scan size 11x17.

.14 Automatic document feeder capacity - 50 sheets.

.15 Connectivity- internal and external print servers, plus wireless print servers.

.16 Software - print drivers and installation software.

.17 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.

.18 Provide connection services in each office and meeting room for the printer. Provide technical services to assist the Contract Administrator, City and its representatives to connect to the Wi-Fi and printing system.

.19 Provide and pay for the services of a security alarm system and take every reasonable precaution to protect the office and its contents against fire and theft, or other damage. Indemnify the Contract Administrator and its agents against loss by fire, theft and injury to the building, to the office or its contents.

.20 Maintain the field office and the performance of the office equipment as specified until at least three (3) months following Substantial Performance.

.21 Provide parking space with a satisfactory wearing surface to accommodate two (2) vehicles minimum. Provide a walkway from the office doors to the parking area and keep both free of water, mud, ice and snow.

1.10 Sanitary Facilities

.1 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.

.2 Maintain facilities with all required toilet room supplies in a clean and sanitary condition and disinfect frequently.

.3 Prohibit the committing of nuisance on the site and any employee found violating such a provision shall be promptly discharged.

.4 Remove any contaminated soil and replace with fresh clean material. Leave Site in a clean sanitary condition.

.5 The Contractor is to secure premises to prevent use by external parties. Provide signage as necessary.

1.11 Construction Signage

.1 No signs or advertisements, other than those required by funding parties or other than warning and traffic signs, are permitted on Site.

.2 Signs and notices for safety and instruction to CAN/CSA-Z321.

.3 Maintain approved signs and notices in good condition for duration of project and dispose of off Site on completion of project or earlier if directed by the Contract Administrator.

1.12 Protection and Maintenance of Traffic

.1 Provide access and temporary relocated roads as necessary to maintain traffic.

.2 Maintain and protect traffic on affected roads during the construction period except as otherwise specifically directed by the Contract Administrator.

.3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs.

.4 Protect travelling public from damage to person and property.

.5 Contractor's traffic on roads selected for hauling material to and from Site to interfere as little as possible with public traffic.

.6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.

.7 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.

.8 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.

.9 Provide snow removal during period of Work.

.10 Remove, upon completion of Work, haul roads designated by the Contract Administrator.

1.13 Clean-Up

.1 Remove construction debris, waste materials, packaging material from Work Site daily.

.2 Clean dirt or mud tracked onto paved or surfaced roadways.

.3 Store materials resulting from demolition activities that are salvageable.

.4 Stack stored new or salvaged material in construction facilities.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

TEMPORARY BARRIERS AND ENCLOSURES

1. GENERAL

1.1 References

.1 Canadian General Standards Board (CGSB):

.1 CGSB 1.59-(97), Alkyd Exterior Gloss Enamel.

.2 CAN/CGSB 1.189-(00), Exterior Alkyd Primer for Wood.

.2 Canadian Standards Association (CSA International):

.1 CSA-O121-(M1978(R2003)), Douglas Fir Plywood.

1.2 Installation and Removal

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from Site all such work after use.

1.3 Hoarding

.1 Erect temporary site enclosures using 38 x 89 mm construction grade lumber framing at 600 mm centres and 1200 x 2400 x 13 mm exterior grade fir plywood to CSA O121.

.2 Apply plywood panels vertically flush and butt jointed.

1.4 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.

1.5 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.

1.6 Dust Tight Screens

.1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.

.2 Maintain and relocate protection until such Work is complete.

1.7 Access to Site

.1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.8 Fire Routes

.1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.9 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.

1.10 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 three (3) days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

1.11 Waste Management and Disposal

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction Waste Management Disposal.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 Description

.1 This Section contains the general requirements of products, materials and workmanship. This Section supplements but does not supersede specific requirements found elsewhere in the Construction Contract.

1.2 Products and Materials

.1 Quality:

.1 Products, materials, equipment and articles incorporated in the Works to be new, not damaged or defective, and of the best quality compatible with Specifications for the purpose intended.

.2 Defective products, whenever identified will be rejected, regardless of previous inspections. Remove and replace defective products and be responsible for delays and expenses caused by rejection.

.3 Should any dispute arise as to the quality or fitness of products, the decision rests solely with the Contract Administrator based upon the requirements of the Construction Contract.

.4 Unless otherwise indicated in the Specifications, maintain uniformity of manufacture for any particular or like item throughout the Works.

.5 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

.6 Preliminary acceptance of equipment or Products listed by supplier names will not in any way constitute a waiver of the Specifications covering such equipment; final acceptance will be based on full conformity with the Construction Contract.

.2 Availability:

.1 Review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify the Contract Administrator of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

1.3 Manufacturer's Instructions

.1 Unless otherwise indicated in the Specifications, install or erect products in accordance with Manufacturer's instructions.

.2 Notify the Contract Administrator a minimum of four (4) weeks prior to installation, in writing, of conflicts between the Specifications and Manufacturer's instructions.

.3 Improper installation or erection of products, due to failure in complying with these requirements, to be removed and reinstalled at no increase in Construction Contract Price.

1.4 Workmanship

.1 General:

.1 Employ only workers experienced and skilled in the respective duties for which they are employed to obtain workmanship of the best quality.

.2 Coordination:

.1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

.3 Coordinate all the Work of all Subcontractors.

.4 Confirm in writing that all Subcontractors examine the full set of Drawings and Specifications for other parts of the Works which may affect the performance of their work.

.5 Ensure that sleeves, openings and miscellaneous foundations are provided as required for the Works.

.6 Ensure that items to be built in are supplied when required with all necessary templates, measurements and Shop Drawings.

.3 Protection of Work in Progress:

.1 Protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired at no cost to the City.

.2 Prevent overloading of any structure.

.4 Remedial:

.1 Remedy, repair or replace the parts or portions of the Works identified as defective or unacceptable. Coordinate adjacent affected Work as required.

.2 Perform remedial work by specialists familiar with the materials affected. Perform in a manner to neither damage nor endanger any portion of Works.

1.5 Quantities

.1 Schedules of equipment piping, fittings, or other materials indicating quantity and/or dimension, which are shown in the Construction Contract, are not guaranteed to be accurate and are to be checked by the Contractor.

.2 Claims for additional payment resulting from variations between quantities shown and those actually installed will not be accepted.

1.6 Metric Project

.1 This Work is designed and is to be constructed in the SI Metric system of measurements.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

COMMON PRODUCT REQUIREMENTS

1. GENERAL

1.1 References

.1 Within text of each Specification Section, reference may be made to reference standards.

.2 Conform to these reference standards, in whole or in part as specifically requested in the Specifications.

.3 If there is question as to whether products or systems are in conformance with applicable standards, the Contract Administrator reserves the right to have such products or systems tested to prove or disprove conformance.

.4 Cost for such testing will be borne by the City in event of conformance with Construction Contract Documents or by the Contractor in event of non-conformance.

.5 Conform to latest date of issue of referenced standards in effect on date of submission of Bids.

1.2 Quality

.1 Products, materials, equipment and articles incorporated in the Work shall be new, not damaged or defective, and of the best quality for the purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is a precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.3 Should disputes arise as to quality or fitness of products, decision rests strictly with the Contract Administrator based upon the requirements of the Construction Contract Documents.

.4 Unless otherwise indicated in the Specifications, maintain uniformity of manufacture for any particular or like item throughout building.

.5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 Storage, Handling and Protection

.1 Handle and store products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in the Work.

.3 Store products subject to damage from weather in weatherproof enclosures.

.4 Store cementious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials and lumber. on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in a heated and ventilated room. Remove oily rags and other combustible debris from Site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged products at own expense and to the satisfaction of the Contract Administrator.

.9 Touch-up damaged factory finished surfaces to Contract Administrator’s satisfaction. Use touch-up materials to match original. Do not paint over nameplates.

1.4 Transportation

.1 Pay costs of transportation of products required in performance of Work.

1.5 Manufacturer's Instructions

.1 Unless otherwise indicated in the Specifications, install or erect products in accordance with the Manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

.2 Notify the Contract Administrator in writing, of conflicts between the Specifications and the Manufacturer's instructions, so that the Contract Administrator will establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Contract Administrator to require removal and re-installation at no increase in Construction Contract Price or Construction Contract Time.

1.6 Quality of Work

.1 Ensure Quality of Work is of the highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify the Contract Administrator if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. The Contract Administrator reserves the right to require dismissal from Site workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with the Contract Administrator, whose decision is final.

1.7 Co-Ordination

.1 See to the co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.8 Concealment

.1 In finished areas conceal pipes, ducts and wiring in the floors, walls and ceilings, except where indicated otherwise.

.2 Before installation inform the Contract Administrator if there is interference. Install as directed by the Contract Administrator.

1.9 Remedial Work

.1 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.10 Location of Fixtures

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform the Contract Administrator of conflicting installation. Install as directed.

1.11 Fastenings

.1 Provide metal fastenings and accessories in the same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the affected Specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.12 Fastenings - Equipment

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use Type 316 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.13 Protection of Work In Progress

.1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of the Contract Administrator.

1.14 Existing Utilities

.1 When breaking into or connecting to existing services or utilities, execute the Work at times directed by local governing authorities and or the Contract Administrator, with a minimum of disturbance to the Work, and/or building occupants, pedestrian and vehicular traffic.

.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in a manner approved by the Authority Having Jurisdiction. Stake and record the location of the capped service.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

EQUIPMENT INSTALLATION

1. GENERAL

1.1 Expertise and Responsibility

.1 The Contract Administrator recognizes the expertise of the Manufacturer.

.2 Should the Contract Administrator issue an Addendum, Field Order, Change Order, or Instruction to change the Work which would, in the opinion of the Contractor, compromise the success or safety of the Work, then it shall be incumbent on the Contractor to notify in writing the Contract Administrator to this effect within two (2) days.

1.2 Equipment Delivery

.1 Ten (10) days before delivery, notice shall be given to the Contract Administrator so that arrangements for receipt and inspection can be made. The shipping lists of materials will be carefully checked by the Manufacturer's Representative in the presence of the Contract Administrator and the Contractor. When the Contractor accepts the equipment delivery, he shall certify the delivery by completing Form 100 – Certificate of Equipment Delivery, attached to this Specification.

.2 The Contractor shall be responsible for setting up and paying for alternate site storage if required. All storage shall meet the Prepurchased Supplier's requirements for temperature and humidity and physical storage.

.3 The Contractor shall be responsible for all equipment at the Site or any alternative storage location.

.4 The Contractor shall ensure that he is fully informed of precautions to be taken in the unloading of the equipment and subsequent storage including any required maintenance.

.5 If off Site storage of equipment is required, then the second move of the equipment to the Site will be at the Contractor's cost.

1.3 Installation Assistance

.1 Before commencing installation of the equipment, the Contractor shall arrange for the attendance of the Manufacturer's Representative to provide instructions in the methods, techniques, precautions, and any other information relevant to the successful installation of the equipment.

.2 The Contractor shall inform the Contract Administrator, in writing, of the attendance at the Site of any Manufacturer's Representative for installation training at least fourteen (14) days prior to arrival.

.3 When the Manufacturer's Representative is satisfied that the Contractor is aware of all installation requirements, he shall so certify by completing Form 101 – Certificate of Readiness to Install attached to this Specification.

.4 The completed form shall be delivered to the Contract Administrator prior to departure of the Manufacturer's Representative from the Site.

.5 Installation of the equipment shall not commence until the Contract Administrator has advised that he has received the completed Form 101.

.6 Separate copies of Form 101 shall be used for different equipment.

1.4 Installation

.1 If necessary, or if so directed by the Contract Administrator during the course of installation, the Contractor shall contact the Manufacturer's Representative to receive clarification of installation procedures, direction, or any other additional information necessary to continue or complete the installation in an appropriate manner.

.2 If it is found necessary, or if so directed by the Contract Administrator, the Contractor shall arrange for the Manufacturer's Representative to visit the Site to provide assistance during installation, all at the Contractor's cost.

.3 Prior to completing installation, the Contractor shall inform the Manufacturer's Representative and arrange for the attendance at the Site of the Manufacturer's Representative to verify successful installation.

.4 The Manufacturer's Representative shall conduct a detailed inspection of the installation including alignment, electrical connections, belt tensions, rotation direction, running clearances, lubrication, workmanship and all other items as required to ensure successful operation of the equipment.

.5 The Manufacturer's Representative shall identify any outstanding deficiencies in the installation.

.6 The deficiencies shall be rectified by the Contractor and the Manufacturer's Representative will be required to re-inspect the installation, at the Contractor's cost.

.7 When the Manufacturer's Representative accepts the installation, he shall certify the installation by completing Form 102 – Certificate of Satisfactory Installation, attached to this Specification.

.8 Deliver the completed Form 102 to the Contract Administrator prior to departure of the Manufacturer's Representative from the Site.

.9 Tag the equipment with a 100 mm by 200 mm card stating "EQUIPMENT CHECKED. DO NOT RUN." stencilled in large black letters. Sign and date each card.

.10 Provide separate copies of Form 102 for different equipment.

1.5 Operation and Performance Verification

.1 Equipment will be subjected to a demonstration, running test, and performance test after the installation has been verified and any identified deficiencies have been remedied.

.2 Inform the Contract Administrator at least fifteen (15) days in advance of conducting the tests and arrange for the attendance of the Manufacturer's Representative.

.3 The Manufacturer's Representative shall conduct all necessary checks to the equipment and if necessary, advise the Contractor of any further checking, flushing, cleaning, or other work needed prior to confirming the equipment is ready to run.

.4 The Contractor shall then operate the equipment for at least one (1) hour to demonstrate the operation of the equipment and any required ancillary services. Any remedial measures required to ensure satisfactory operation shall be promptly undertaken.

.5 The Contractor shall supply all water, chemicals, temporary power, heating, and/or any other ancillary equipment or services required to complete the initial operation of the equipment.

.6 Should the initial operation of the equipment reveal any defects, then those defects shall be promptly rectified and the demonstration, running tests, and/or performance tests shall be repeated to the satisfaction of the Contract Administrator. Additional costs incurred by the Contractor, or the Contract Administrator, due to repeat initial operation shall be the responsibility of the Contractor.

.7 Refer to Section 01 91 31 for Demonstration, Running and Performance Test requirements.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

We certify that the equipment listed below has been received and delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Contractor) Date

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

CERTIFICATE OF READINESS TO INSTALL
FORM 101

I have familiarized the Contractor of the specific installation requirements related to the equipment listed below and am satisfied that he understands the required procedures.

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

I certify that I have received satisfactory installation instructions from the equipment Manufacturer/ Supplier.

_____ _____
(Authorized Signing Representative of the Contractor) Date

CERTIFICATE OF SATISFACTORY INSTALLATION
FORM 102

I have completed my check and inspection of the installation listed below and confirm that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

OUTSTANDING DEFECTS: _____

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Contractor) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

END OF SECTION

1. GENERAL

1.1 Work Included

.1 This Section specifies the delivery, installation, testing and commissioning of the Ultraviolet Disinfection System, the Gates and Actuators, two sets of Transformers and the 600 Volt Motor Control Centres as shown on the Drawings and specified herein (Appendices B, C, D and H).

.2 The Ultraviolet Disinfection System was prepurchased by the City via separate contract. (Hereafter referred to as the Supply of Ultraviolet Disinfection System Contract). Appendix B.

.3 The Slide and Weir Gates and Actuators were prepurchased by the City via separate contract. (Hereafter referred to as the Supply of Gates and Actuators Contract). Appendix H.

.4 The 600 Volt Motor Control Centres were prepurchased by the City via separate contract. (Hereafter referred to as the Supply of 600 Volt Motor Control Centres Contract). Appendix C.

.5 The 4160 V to 600 V and 4160 V to 480 V transformers were prepurchased by the City via separate contract. (Hereafter referred to as the Supply of Transformers Contract). Appendix D.

.6 Supply of Ultraviolet Disinfection System includes all equipment and appurtenances as listed in the Equipment Supply Contractor's Equipment List (see Appendix B). It is the Contractor's responsibility to familiarize themselves with the Supply of Ultraviolet Disinfection System Contract and contact the Ultraviolet Disinfection System Supplier to request clarification where required.

.7 The Shop Drawings for the Supply of Gates and Actuators, the Supply of 600 V Motor Control Centres, and the Supply of Transformers Contract are not provided with this Specification but will be available upon project award.

.8 Responsibilities of the Contractor include, but are not limited to:

.1 Coordinating receipt of the prepurchased equipment upon delivery.

.2 Off-loading and storage of all equipment.

.3 Coordinate installation training for the equipment.

.4 Install all equipment and materials provided under the Supply of Ultraviolet Disinfection System Contract, in accordance with the instructions provided by the Ultraviolet Disinfection System Supplier and as specified.

.5 Contractor is responsible to position all components of the prepurchased equipment on Site.

.6 Supply and installation of all external piping, pumps and valves between prepurchased equipment/skid packages and other equipment.

.7 Supply and install of all electrical wiring and electrical conduit for prepurchased equipment.

.8 Supply and install data communication cable from the plant Process Control System (PCS) to the process PLC control system.

.9 Conduct testing, performance verification and commissioning of the equipment, in cooperation with the Ultraviolet Disinfection System Supplier.

.10 Supply and install all anchor bolts for equipment.

.11 Construction of concrete housekeeping pads for all equipment.

.12 The Contractor is required to provide and install all cabling, cable tray, piping, valves etc. not provided by the prepurchased equipment, as shown in the Drawings and Specifications.

.13 The Contractor is required to provide and install all interconnection pipe and cabling required to connect all prepurchased equipment supplied skid mounted equipment.

.14 Coordinate operation and maintenance training for the equipment.

.15 Coordinate operation and maintenance material from prepurchased equipment for inclusion in the project O&M Manuals.

.16 Authorizing signing representative of the Contractor must sign off on Forms 100, 101, 102, and 103 (Section 01 65 00) for all prepurchased equipment.

1.2 Coordination

.1 Coordinate with other Divisions to ensure that there is no conflict with the Work.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Manufacturer's Representative

.1 The Prepurchase Suppliers will provide a technically qualified Manufacturer's Representative as per the Contracts. Arrange for the Manufacturer's Representative to:

.1 Certify equipment delivery.

.2 Provide storage requirements.

.3 Provide installation training.

.4 Certify acceptable equipment installation.

.5 Attend and certify equipment performance testing.

.6 Provide O&M manuals and operator training.

3.2 Delivery, Protection, and Storage

.1 Prepurchased equipment will be delivered to and stored at a location identified by the Contractor. The Contractor shall offload and accept equipment delivery. The cost for storage, pick-up and delivery of equipment from the Contractor's storage location to the jobsite will be borne by the Contractor.

.2 Contractor to provide suitable storage for all prepurchased equipment. Note electrical equipment, including all PLC's, may require climate controlled rooms to prevent overheating or freezing of sensitive electronic components.

.1 Prepurchased equipment must be stored in a sheltered area, protected from freezing, direct sunlight or extreme heat and sealed as shipped until ready for use. Storage should be in a dark, dry, level area out of direct sunlight and at a temperature of 5-30°C.

.3 The Contractor shall be responsible for the security and safekeeping of all equipment at the jobsite.

.4 The Contractor shall ensure that they are fully informed of precautions to be taken in the unloading of equipment and its subsequent storage including any required maintenance.

.5 All forms referred to in this Section (Forms 100, 101, 102 and 103) will be completed by the Ultraviolet Disinfection System Supplier, and the Contractor as detailed below.

.6 Prior to accepting any of the prepurchased equipment, the Contractor shall inspect the equipment. A representative from each of the following groups will be in attendance at the time of pick-up and delivery: the Supply Contractor, Construction Contractor, and Contract Administrator. A duly executed Form 100 – Certificate of Equipment Delivery shall be completed. Any minor damage identified during the inspection shall be repaired at the Supplier's cost. Any severe damage will be grounds for rejection of the equipment. The severely damaged equipment will be replaced at the Supplier's cost. The Contractor shall accept the prepurchased equipment and assume risk and responsibility for the equipment and fill out Form 100 - Certificate of Equipment Delivery.

.7 If the Ultraviolet Disinfection System Supplier's inspection reveals any deficiencies in the equipment, then these shall be noted in writing prior to the Contractor accepting the equipment. Only deficiencies noted and documented in the foregoing manner will be deemed not the responsibility of the Contractor.

.8 The Contractor shall be responsible for the installation of prepurchased equipment in addition to all equipment supplied under this Construction Contract.

.9 For the purposes of Form 100, the Prepurchased equipment supplier will be the Manufacturer.

3.3 Installation

.1 The Prepurchased equipment suppliers will provide the services of a qualified representative to assist in the installation, startup, and performance testing of all equipment. Forms 100, 101 and 102 will need to be completed for all the Prepurchased equipment.

.2 The Ultraviolet Disinfection System Supplier will provide the services of a qualified representative to assist in the installation, start-up, and performance testing of all of the equipment. The Contractor shall refer to Sections 01 65 00 – Equipment Installation, for details on the services and procedures not included in this Section. The services to be performed by the Ultraviolet Disinfection System Supplier are as follows:

.1 Prior to the Contractor beginning the installation, the Ultraviolet Disinfection System Supplier will provide to the Contractor instructions and advice regarding the detailed requirements for the equipment installation. The Ultraviolet Disinfection System Supplier will be required to provide a Certificate of Readiness to Install, Form 101. The Contractor shall be required to sign Form 101 to acknowledge that he has received adequate instruction. During installation, if the Contractor has additional questions regarding installation requirements or procedures, he shall contact the Ultraviolet Disinfection System Supplier, with the assistance of the Contract Administrator, as required. No additional compensation to the Contractor based on claims of inadequate training from the Ultraviolet Disinfection System Supplier will be entertained should he install equipment improperly.

.2 Following the completion of the installation, the Ultraviolet Disinfection System Supplier will inspect the installation of the equipment to verify that it has been installed in accordance with the Ultraviolet Disinfection System Supplier's requirements. The Ultraviolet Disinfection System Supplier will be required to provide a Certificate of Satisfactory Installation, Form 102. If any deficiencies in the installation exist at the time of inspection, these shall be noted on Form 102. The Contractor shall be responsible for the prompt correction of these deficiencies prior to performance testing of the equipment.

.3 The Ultraviolet Disinfection System Supplier shall assist the Contractor in Performance Testing of the equipment.

.4 The Ultraviolet Disinfection System Supplier shall provide site visits for inspection of installation and for assistance of Performance Testing as per the Supply of Ultraviolet Disinfection System Contract.

3.4 Commissioning and Process Performance Testing

.1 Refer to Section 01 91 31 for all general commissioning requirements.

.2 The Contractor is responsible for Commissioning of the Ultraviolet Disinfection System which includes all other the prepurchased equipment, and all other equipment specified in this Section and to ensure the equipment functions as intended in the process systems.

.3 Inform the Contract Administrator at least fourteen (14) days in advance of conducting the tests. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Contractor and the Contract Administrator.

.4 The Ultraviolet Disinfection System Supplier and all other Prepurchase suppliers will conduct all necessary checks to equipment as per the Contract and if necessary, advise the Contractor of any further checking, flushing, cleaning, or other work needed prior to confirming the equipment is ready to run.

.5 The Contractor shall then operate the equipment for at least one (1) hour to demonstrate the operation of the equipment and any required ancillary services. Any remedial measures required to ensure satisfactory operation shall be promptly undertaken.

.6 Demonstration:

.1 The Contractor shall notify the Contract Administrator of his readiness to demonstrate the operation of the equipment. The Contract Administrator shall attend, as expeditiously as possible.

.2 With the assistance of the Ultraviolet Disinfection System Supplier, the Contractor shall demonstrate that the equipment is properly installed. Alignment, hose connections, electrical connections, etc. will be checked and if appropriate, code certifications provided.

.3 The equipment shall then be run for one (1) hour. Local controls shall be satisfactorily verified by cycling the equipment through several start-stop operations, modulating its output, or some combination. Operating parameters such as temperature, pressure, voltage, vibration, etc., will be checked to ensure that they are within the specified or Ultraviolet Disinfection System Supplier's recommended limits, whichever is more stringent.

.4 On satisfactory completion of the one (1) hour demonstration, the equipment shall be stopped and critical parameters, such as alignment, shall be rechecked.

.7 Running Test:

.1 The equipment shall be restarted and run continuously for a minimum of three (3) days (72 hours) or as specified. During this period, as practicable, conditions shall be simulated which represent maximum or most severe, average, and minimum or least severe conditions. These conditions will be mutually agreed by the Supplier, the Contractor, and Contract Administrator on the basis of the information contained in the technical specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.

.8 Performance Tests:

.1 Performance tests shall be conducted either concurrent with or subsequent to the running test, as practicable and agreed between the Contract Administrator, the Prepurchase Suppliers, and the Contractor.

.2 The equipment shall be run continuously for a minimum of fourteen (14) days for final performance testing and seven (7) days for start-up during four (4) month UV shutdown period.

.3 Performance tests shall be as dictated in the technical specifications for each item of equipment or as reasonably required by the Contract Administrator to prove adherence to the requirements listed in the specification.

.4 The Contractor shall submit the results of the performance tests within twenty four (24) hours to the Contract Administrator, and final documented and summarized results in a format acceptable to the Contract Administrator within seven (7) calendar days. The Contract Administrator reserves the right to request additional testing. No equipment

shall be accepted and handed over to the City prior to the satisfactory completion of the performance test(s) and receipt of the test reports.

.9 All water, chemicals, temporary power (except portable generators), heating, or any other ancillary services required to complete the initial demonstration, running test and performance tests are the responsibility of the Contractor.

.10 Should the initial demonstration, running test or performance tests reveal any defects, then those defects shall be promptly rectified and the demonstration, running tests, and / or performance tests shall be repeated to the satisfaction of the Contract Administrator. Additional costs incurred by the Contractor, the Contract Administrator, or the City, due to repeat demonstration, running tests, and/or performance tests shall be the responsibility of the Contractor or Ultraviolet Disinfection System Supplier as determined by the Contract Administrator.

.11 On successful completion of the demonstration, running test, and performance tests, Form 103 – Certificate of Equipment Satisfactory Performance attached to Section 01 65 00 – Equipment Installation will be signed by the Prepurchase Suppliers, the Contractor, and the Contract Administrator.

.12 Cooperate with the Prepurchase Suppliers to fulfill the requirements for successful testing of the equipment. Execute Form 103 - Certificate of Satisfactory Equipment Testing.

.13 The Contractor is responsible to complete the Process Performance Testing of all equipment, which includes the equipment specified in this Section, and to ensure the equipment functions as intended.

.14 The Ultraviolet Disinfection System Supplier is responsible to provide all testing instructions, oversee performance testing and is responsible for the overall performance of the treatment system.

.15 Cooperate with the Prepurchase Suppliers to fulfill the requirements for successful process performance testing of the equipment. Execute Form 104 - Certificate of Satisfactory Process Performance.

3.5 Training

.1 Arrange and coordinate the O&M training included in the scope of services specified in the Prepurchase Suppliers Contracts.

END OF SECTION

1. GENERAL

1.1 References

.1 The Contract Administrator's identification of existing survey control points and property limits.

1.2 Qualifications of Surveyor

.1 Qualified registered land surveyor, licensed to practice in Manitoba, acceptable to Contract Administrator.

1.3 Survey Reference Points

.1 Existing base horizontal and vertical control points are designated on the Drawings.

.2 Locate, confirm and protect control points prior to starting Site Work. Preserve permanent reference points during construction.

.3 Make no changes or relocations without prior written notice to the Contract Administrator.

.4 Report to the Contract Administrator when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

.5 Require surveyor to replace control points in accordance with original survey control.

1.4 Survey Requirements

.1 Establish one (1) permanent bench mark on Site, referenced to established bench marks by survey control points. Record locations with horizontal and vertical data in Project Record Documents.

.2 Establish lines and levels, locate and lay out, by instrumentation.

.3 Stake for grading, fill and topsoil placement and landscaping features.

.4 Stake slopes and berms.

.5 Establish pipe invert, catch basin and manhole elevations.

.6 Stake batter boards for foundations.

.7 Establish foundation column locations and floor elevations.

.8 Establish lines and levels for mechanical and electrical work.

1.5 Existing Services

.1 Before commencing Work, establish location and extent of service lines in area of the Work and notify the Contract Administrator of the findings.

.2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by the Contract Administrator at no cost to the City.

1.6 Location of Equipment and Fixtures

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with the Manufacturer's Recommendations for safety, access and maintenance.

.3 Inform the Contract Administrator of impending installation and obtain approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment when required by the Contract Administrator.

1.7 Records

.1 Maintain a complete, accurate log of control and survey Work as it progresses.

.2 On completion of foundations and major Site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of the Work.

.3 Record locations of maintained, re-routed, and abandoned service lines.

1.8 Action and Informational Submittals

.1 Submit name and address of Surveyor to the Contract Administrator.

.2 On request of the Contract Administrator, submit documentation to verify accuracy of the field engineering Work.

.3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform to the Construction Contract Documents.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

EXECUTION

1. GENERAL

1.1 Action and Informational Submittals

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

.2 Submit written request in advance of cutting or alteration which affects:

.1 Structural integrity of elements of project.

.2 Integrity of weather-exposed or moisture-resistant elements.

.3 Efficiency, maintenance, or safety of operational elements.

.4 Visual qualities of sight-exposed elements.

.5 Work of the City, Contract Administrator, or separate contractor.

.6 Include in request:

.1 Identification of project.

.2 Location and description of affected Work.

.3 Statement on necessity for cutting or alteration.

.4 Description of proposed Work, and products to be used.

.5 Alternatives to cutting and patching.

.6 Effect on Work of the City, Contract Administrator, or separate contractor.

.7 Written permission of affected separate contractor.

.8 Date and time work will be executed.

1.2 Materials

.1 Required for original installation.

.2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.3 Preparation

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of Work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

.4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

.5 Provide protection from elements for areas that are to be exposed by uncovering work; maintain excavations free of water.

1.4 Execution

.1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.

.2 Fit several parts together, to integrate with other Work.

.3 Uncover Work to install ill-timed Work.

.4 Remove and replace defective and non-conforming Work.

.5 Remove samples of installed Work for testing.

.6 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

.7 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.

.8 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

.9 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.

.10 Restore work with new products in accordance with requirements of Construction Contract Documents.

.11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.12 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00 - Firestopping, full thickness of the construction element.

.13 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

.14 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CLEANING

1. GENERAL

1.1 Project Cleanliness

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by the Contract Administrator or other Contractors.

.2 Remove waste materials from the Site at weekly regularly scheduled times or dispose of as directed by the Contract Administrator or the City. Do not burn waste materials on Site.

.3 Clear snow and ice from access to Site.

.4 Make arrangements with and obtain permits from Authorities Having Jurisdiction for disposal of waste and debris.

.5 Provide on-site containers for collection of waste materials and debris.

.6 Provide and use marked separate bins for recycling. Refer to Section 01 74 19 - Construction Waste Management Disposal.

.7 Dispose of waste materials and debris at designated dumping areas off Site.

.8 Clean interior areas prior to start of finishing work and maintain areas free of dust and other contaminants during finishing operations.

.9 Store volatile waste in covered metal containers and remove from premises at end of each working day.

.10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 Final Cleaning

.1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of the remaining Work.

.2 Remove waste products and debris other than that caused by others and leave Work clean and suitable for occupancy.

.3 Prior to final review remove surplus products, tools, construction machinery and equipment.

.4 Remove waste materials from the Site at regularly scheduled times or dispose of as directed by the Contract Administrator. Do not burn waste materials on Site.

.5 Make arrangements with and obtain permits from Authorities Having Jurisdiction for disposal of waste and debris.

.6 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass

.7 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.

.8 Clean lighting reflectors, lenses, and other lighting surfaces.

.9 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.10 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

.11 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.12 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.13 Remove dirt and other disfiguration from exterior surfaces.

.14 Clean and sweep roofs, gutters, areaways, and sunken wells.

.15 Sweep and wash clean paved areas.

.16 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment. Clean or replace filters of electrical equipment.

.17 Clean roofs, downspouts, and drainage systems.

.18 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.19 Remove snow and ice from access to building.

1.3 Waste Management and Disposal

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction Waste Management and Disposal.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CONSTRUCTION WASTE MANAGEMENT DISPOSAL

1. GENERAL

1.1 Waste Management Goals

.1 Accomplish maximum control of solid construction waste.

.2 Preserve environment and prevent pollution and environment damage.

1.2 Definitions

.1 Class III: non-hazardous waste - construction renovation and demolition waste.

.2 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.

.3 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.

.4 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.

.5 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.6 Separate Condition: refers to waste stored into individual types.

.7 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.

1.3 Documents

.1 Maintain at job Site, one (1) copy of following documents:

.1 Material Source Separation Plan.

1.4 Action and Informational Submittals

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

.2 Prepare and submit following prior to project start-up:

.1 Submit two (2) copies of Materials Source Separation Program (MSSP) description.

1.5 Materials Source Separation Program (MSSP)

.1 Prepare MSSP and have ready for use prior to project start-up.

.2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Contract Administrator.

.3 Provide on-Site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.

.4 Provide containers to deposit reusable and recyclable materials.

.5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.

.6 Locate separated material(s) in area(s) which minimize material damage.

.7 Collect, handle, store on-Site, and transport off-site, salvaged materials in separate condition.

.1 Transport to approved and authorized recycling facility.

.8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.

.1 Ship materials to site operating under Certificate of Approval.

.2 Materials must be immediately separated into required categories for reuse or recycling.

1.6 Storage, Handling and Protection

.1 Store, materials to be reused, recycled and salvaged in locations as directed by Contract Administrator.

.2 Unless specified otherwise, materials for removal do not become Contractor's property.

.3 Protect, stockpile, store and catalogue salvaged items.

.4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.

.5 Protect surface drainage, mechanical and electrical from damage and blockage.

.6 Separate and store materials produced during dismantling of structures in designated areas.

.7 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.

.1 On-Site source separation is recommended.

.2 Remove co-mingled materials to off-site processing facility for separation.

.3 Provide waybills for separated materials.

1.7 Disposal of Wastes

.1 Do not bury rubbish or waste materials.

.2 Do not dispose of waste into waterways, storm, or sanitary sewers.

1.8 Use of Site and Facilities

.1 Execute Work with least possible interference or disturbance to normal use of premises.

.2 Provide temporary security measures approved by Contract Administrator.

1.9 Scheduling

.1 Co-ordinate Work with other activities at Site to ensure timely and orderly progress of Work.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Application

.1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 Cleaning

.1 Remove tools and waste materials on completion of Work and leave work area in clean and orderly condition.

.2 Clean-up work area as Work progresses.

.3 Source separate materials to be reused/recycled into specified sort areas.

3.3 Diversion of Materials

.1 The diversion of waste material from landfills is highly encourages. Separate recyclable and reusable materials where possible.

.2 On-Site sale of salvaged, recovered, reusable, or recyclable material is not permitted.

3.4 Canadian Governmental Departments Chief Responsibility for the Environment

.1 Manitoba Sustainable Development:

Province	Address	General Inquiries
Manitoba	Province of Manitoba Conservation and Water Stewardship Box 22 - 200 Saulteaux Crescent Winnipeg, MB R3J 3W3	204-945-6784

3.5 Cost of Disposal

.1 Contractor to pay all solid waste disposal tipping fees for waste disposed of.

END OF SECTION

CLOSEOUT SUBMITTALS

1. GENERAL

1.1 Submittals

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

.2 Prepare instructions and data using personnel experienced in the maintenance and operation of described products.

.3 A Copy will be returned after final inspection with the Contract Administrator’s comments.

.4 Revise the content of the documents as required prior to final submittal.

.5 Four (4) weeks prior to Substantial Performance of the Work, submit to the Contract Administrator six (6) final paper copies of the Operating and Maintenance (O&M) Manuals and one (1) electronic copy (PDF) on USB drive in S.I. Units.

.6 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of the same quality and manufacture as the products provided in Work.

.7 Furnish evidence, if requested, for type, source and quality of the products provided.

.8 Defective products will be rejected, regardless of previous inspections.

1.2 Format

.1 Organize data as an instructional manual.

.2 Binders shall be vinyl, hard covered, 3 'D' ring, loose leaf with spine and face pockets. The maximum width of each binder shall not exceed 125 mm; where there is more data than will fit in a binder of 125 mm maximum width, the number of binders shall be as required.

.3 When multiple binders are used, correlate the data into related consistent groupings. Identify contents of each binder on the spine.

.4 Covers shall be used to identify each binder with type or printed title “Operation and Maintenance Manual”; list date, title of project, City of Winnipeg, Contractor and Contract Administrator, and identify subject matter of contents.

.5 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 The text shall be manufacturer's printed data, or typewritten data.

.8 Drawings shall be provided with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 Provide 1:1 scaled CAD files in dwg format on a USB drive.

.10 Provide one (1) electronic copy (on USB drive) of the entire manual. The electronic copy shall have a linked Table of Contents to each section and shall be word searchable.

1.3 Contents - Each Volume

.1 Table of Contents: provide title of project:

.1 Date of submission; names.

.2 Addresses and telephone numbers of the Contract Administrator and Contractor with the names of responsible parties.

.3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:

.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Drawings larger than 210 mm x 300 mm (A4) shall be contained in plastic pouch. Provide a separate panel for each drawing.

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

.6 Training: refer to Section 01 79 00 - Demonstration and Training.

1.4 As-Builts and Samples

.1 Maintain, in addition to the requirements in the General Conditions, at Site for Contract Administrator one (1) record copy of:

.1 Construction Contract Drawings.

.2 Field test records.

.3 Inspection certificates.

.4 Manufacturer's certificates.

.2 Store record documents and samples in the field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in the List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by the Contract Administrator.

1.5 Recording Actual Site Conditions

.1 Record information on set of Issued for Construction Drawings.

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with the construction progress. Do not conceal Work until required information is recorded.

.4 Construction Contract Drawings and Shop Drawings: mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Construction Contract Drawings.

.7 References to related Shop Drawings and modifications.

.5 Specifications: mark each item to record actual construction, including:

.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.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications, and field test records as required by individual Specifications Sections.

1.6 Final Survey

.1 Submit final Site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with the Construction Contract Documents.

1.7 Equipment and Systems

.1 Each Item of Equipment and Each System: include the description of the 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 Provide copy of reviewed submittals.

.3 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.4 Include installed colour coded wiring diagrams.

.5 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.

.6 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.7 Provide a servicing and lubrication schedule, and a list of lubricants required.

.8 Include Manufacturer's printed O&M instructions.

.9 Include the sequence of operation by the controls Manufacturer.

.10 Provide original Manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.11 Provide installed control diagrams by the controls Manufacturer.

.12 Provide the Contractor's co-ordination drawings, with installed colour coded piping diagrams.

.13 Provide charts of valve tag numbers, with the location and function of each valve, keyed to flow and control diagrams.

.14 Provide a list of original Manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.15 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and Section 01 91 31 - Commissioning Plan.

.16 Additional requirements: as specified in individual Specification Sections.

1.8 Materials and Finishes

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

.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 the 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.

1.9 Spare Parts

.1 Provide spare parts, in quantities specified in individual Specification Sections.

.2 Provide items of the same manufacture and quality as items in the Work.

.3 Deliver to Site; place and store.

.4 Receive and catalogue items. Submit inventory listing to the Contract Administrator. Include approved listings in O&M Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.10 Maintenance Materials

.1 Provide maintenance and extra materials, in quantities specified in the individual Specification Sections.

.2 Provide items of the same manufacture and quality as items in the Work.

.3 Deliver to Site; place and store.

.4 Receive and catalogue items. Submit inventory listing to the Contract Administrator. Include approved listings in the O&M Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.11 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 items. Submit inventory listing to the Contract Administrator. Include approved listings in the O&M Manual.

1.12 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.

1.13 Warranties and Bonds

.1 Develop warranty management plan to contain information relevant to Warranties.

.2 Submit warranty management plan, thirty (30) days before planned pre-warranty conference, to Contract Administrator approval.

.3 Warranty management plan to include required actions and documents to assure that the Contract Administrator receives warranties to which it is entitled.

.4 Provide the plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

.5 Submit warranty information made available during the construction phase, to the Contract Administrator for approval prior to each monthly pay estimate.

.6 Assemble approved information in binder and submit upon acceptance of work. Organize the binder as follows:

.1 Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing.

.2 List Subcontractor, Supplier, and Manufacturer, with name, address, and telephone number of responsible principals.

.3 Obtain warranties and bonds, executed in duplicate by Subcontractors, Suppliers, and Manufacturers, within ten (10) days after completion of the applicable item of Work.

.4 Verify that documents are in proper form, contain full information, and are notarized.

.5 Co-execute submittals when required.

.6 Retain warranties and bonds until time specified for submittal.

.7 Conduct a joint ten (10) month warranty inspection, measured from Substantial Completion, by the Contract Administrator.

.8 Include information contained in the warranty management plan as follows:

.1 Roles and responsibilities of personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of Contractors, Subcontractors, Manufacturers or Suppliers involved.

.2 Provide a list for each warranted equipment, item, feature of construction or system indicating:

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Name and phone numbers of Manufacturers or Suppliers.

.5 Names, addresses and telephone numbers of sources of spare parts.

.6 Warranties and terms of warranty: include one (1) year overall warranty of construction from Substantial Completion. Indicate items that have extended warranties and show separate warranty expiration dates.

.7 Cross-reference to warranty certificates as applicable.

.8 Starting point and duration of the warranty period.

.9 Summary of maintenance procedures required to continue warranty in force.

.10 Cross-Reference to specific pertinent O&M Manuals.

.11 Organization, names and phone numbers of persons to call for warranty service.

.12 Typical response time and repair time expected for various warranted equipment.

.3 Procedure and status of tagging equipment covered by extended warranties.

.4 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

.9 Respond within seventy-two (72) hours to oral or written notification of required construction warranty repair work.

.10 Written verification will follow oral instructions. Failure to respond will be cause for the City to proceed with action against the Contractor.

1.14 Pre-Warranty Conference

.1 Meet with the Contract Administrator, to develop an understanding of the requirements of this Section. Schedule a meeting prior to Construction Contract completion, and at time designated by the Contract Administrator.

.2 The Contract Administrator will establish communication procedures for:

.1 Notification of construction warranty defects.

.2 Determine priorities for type of defect.

.3 Determine reasonable time for response.

.3 Provide name, telephone number and address of licensed and bonded company that is authorized to initiate and pursue construction warranty work action.

.4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.15 Warranty Tags

.1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by the Contract Administrator.

.2 Attach tags with a durable plastic tie.

.3 Leave the date of acceptance until project is accepted for occupancy.

.4 Indicate the following information on the tag:

.1 Type of product/material.

.2 Model number.

.3 Serial number.

.4 Construction Contract number.

.5 Warranty period.

.6 Inspector's signature.

.7 Contractor.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

OPERATION AND MAINTENANCE DATA

1. GENERAL

1.1 Section Includes

.1 Detailed information for the preparation, submission, and Contract Administrator's review of operations and maintenance (O&M) data, as required by individual Specification sections.

1.2 Definitions

.1 Preliminary Data: Initial and subsequent submissions for Contract Administrator's review.

.2 Final Data: Contract Administrator-accepted data, submitted as specified herein.

.3 Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations include but are not limited to lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

.4 Operation and Maintenance Manual: An organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual systems, subsystems and components, including prepurchased equipment, as specified in individual sections of this Specification.

1.3 Sequencing and Scheduling

.1 Equipment and System Data:

.1 Preliminary Data:

.1 Do not submit until Shop Drawing for equipment or system has been reviewed and returned stamped "NO EXCEPTIONS TAKEN" or "EXCEPTIONS NOTED" by Contract Administrator.

.2 Submit prior to shipment date.

.2 Final Data:

.1 Submit an O&M Manual not less than thirty (30) days prior to equipment or system field Functional Testing.

.2 Final accepted O&M Manuals are a required prior to Substantial Performance being granted.

1.4 Data Format

.1 Preliminary Manual Format:

.1 Binder: Commercial quality, permanent, three-ring binders with durable plastic cover.

.1 Three hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.

.2 Size: 8-1/2 inches by 11 inches, minimum.

.3 Cover: Identify manual with typed or printed title "OPERATION AND MAINTENANCE DATA, VOLUME NO._OF____"," and list:

.1 Project title.

.2 Contractor's name, address, and telephone number.

.3 If entire volume covers equipment or system provided by one supplier include the following:

.1 Identity of general subject matter covered in manual.

.2 Identity of equipment number and Specification section.

.4 Provide each volume with title page and typed table of contents with consecutive page numbers. Place contents of entire set, identified by volume number, in each binder.

.5 Table of contents neatly typewritten, arranged in a systematic order:

.1 Include list of each product, indexed to content of each volume.

.2 Designate system or equipment for which it is intended.

.3 Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.

.6 Section Dividers:

.1 Heavy, 80 pound cover weight, tabbed with numbered plastic index tabs.

.2 Fly-Leaf:

.1 For each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment.

.2 List with each product:

.1 Name, address, and telephone number of Subcontractor, supplier, installer, and maintenance contractor, as appropriate.

.2 Identify area of responsibility of each.

.3 Provide local source of supply for parts and replacement.

.3 Identity of separate structure as applicable.

.4 Maintenance Summary (Format in accordance with paragraph 1.6.4)

.7 Assemble and bind material in same order as specified in the Contract Documents.

.8 Material shall be suitable for reproduction, with quality equal to original.

.2 Final Instructional Manual Format:

.1 Compile all Contract Administrator-accepted preliminary O&M data into a hard-copy, hard-bound set as detailed in Section 1.2.1 above and in electronic media format as described in paragraph 1.4.3.

.3 Electronic Media Format:

.1 Portable Document Format (PDF):

.1 After all preliminary data has been found to be acceptable to Contract Administrator, upload electronic copies of O&M data to the City's DMS (Aconex) in PDF format and in native file format as applicable.

.2 Files to be exact duplicates of Contract Administrator-accepted preliminary data. Arrange by specification number and name.

.3 Files to be fully functional and viewable in most recent version of Adobe Acrobat.

.4 PDF files to be indexed and searchable.

.5 CD Cover: Identify with typed or printed title "OPERATION AND MAINTENANCE DATA, VOLUME NO.____OF____"," and list:

.1 Project title.

.2 Contractor's name, address, and telephone number.

.3 Identity of equipment number and Specification section.

1.5 Submittals

.1 Informational:

.1 Data Outline: Submit an electronic copy of a detailed outline of proposed organization and contents of final data prior to preparation of preliminary data.

.2 Preliminary Data:

.1 Submit three (3) hard copies for Contract Administrator's review.

.2 If data meets conditions of the Contract:

.1 One (1) copy will be returned to Contractor.

.2 One (1) copy will be forwarded to The City.

.3 One (1) copy will be retained in Contract Administrator's file.

.3 If data does not meet conditions of the Contract:

.1 Two (2) copies will be returned to Contractor with Contract Administrator's comments (on separate document) for revision.

.2 One (1) copy with comments will be retained in Contract Administrator's file.

.3 Resubmit three (3) copies revised in accordance with Contract Administrator's comments.

.3 Final Data: Submit six (6) hard copies in format(s) specified herein. No red lines on the documents are allowed in final submission.

1.6 Data For Systems, Subsystem and Components

.1 Content for each unit (or common units) and system, including pre-purchased equipment, unless otherwise specified:

.1 Product Data:

.1 Include only those sheets that are pertinent to specific product.

.2 Clearly annotate each sheet to:

.1 Identify specific product(s) or part(s) installed.

.2 Identify data applicable to installation.

.3 Delete references to inapplicable information.

.3 Function, normal operating characteristics, and limiting conditions.

.4 Serial Numbers.

.5 Performance curves, engineering data, nameplate data, and tests reports for all pumps.

.6 Complete nomenclature and commercial number of replaceable parts.

.7 Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.

.8 Spare parts ordering instructions.

.9 Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).

.2 As-installed, color-coded piping diagrams.

.3 Charts of valve tag numbers, with the location and function of each valve.

.4 Drawings: Supplement product data with Drawings as necessary to clearly illustrate:

.1 Format:

.1 Provide reinforced, punched, binder tab; bind in with text.

.2 Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.

.3 Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.

.4 Identify Specification section and product on Drawings and envelopes.

.2 Relations of component parts of equipment and systems.

.3 Control and flow diagrams.

.4 Coordinate drawings with Project record documents to assure correct illustration of completed installation.

.5 Instructions and Procedures: Within text, as required to supplement product data.

.1 Format:

.1 Organize in consistent format under separate heading for each different procedure.

.2 Provide logical sequence of instructions for each procedure.

.3 Provide information sheet for The City's personnel, including:

.1 Proper procedures in event of failure.

.2 Instances that might affect validity of guarantee or Bond.

.2 Installation Instructions: Including alignment, adjusting, calibrating, and checking.

.3 Operating Procedures:

.1 Startup, break-in, routine, and normal operating instructions.

.2 Test procedures and results of factory tests where specified.

.3 Regulation, control, stopping, and emergency instructions.

.4 Description of operation sequence by control manufacturer.

.5 Shutdown instructions for both short and extended duration.

.6 Summer and winter operating instructions, as applicable.

.7 Safety precautions.

.8 Special operating instructions.

.4 Maintenance and Overhaul Procedures:

.1 Routine maintenance.

.2 Guide to troubleshooting.

.3 Disassembly, removal, repair, reinstallation, and re-assembly.

.6 Guarantee, Bond, and Service Agreement: In accordance with Section 01 78 00, Closeout Procedures.

.2 Content for Each Electric or Electronic Item or System:

.1 Description of Unit and Component Parts:

.1 Function, normal operating characteristics, and limiting conditions.

.2 Performance curves, engineering data, nameplate data, and tests.

.3 Complete nomenclature and commercial number of replaceable parts.

.4 Interconnection wiring diagrams, including control and lighting systems.

.2 Circuit Directories of Panelboards:

.1 Electrical service.

.2 Controls.

.3 Communications.

.3 List of electrical relay settings, and control and alarm contact settings.

.4 Electrical interconnection wiring diagram, including control and lighting systems.

.5 As-installed control diagrams by control manufacturer.

.6 ISA S20 data sheets for all instruments.

.7 Operating Procedures:

.1 Routine and normal operating instructions.

.2 Sequences required.

.3 Safety precautions.

.4 Special operating instructions.

.8 Maintenance Procedures:

.1 Routine maintenance.

.2 Guide to troubleshooting.

.3 Adjustment and checking.

.4 List of relay settings, control and alarm contact settings.

.9 Manufacturer's printed operating and maintenance instructions.

.10 List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

.3 Content for Programmable Devices/Components/Sub-systems:

.1 The following requirements are minimum requirements applicable to programmable equipment such as VFDs, ASDs, microprocessor based devices, PLCs, Human-Machine- Interfaces, computers, and other programmable devices. Additional requirements may be specified elsewhere.

.2 As-Constructed version of Shop Drawings.

.3 Functional description.

.4 Wiring details.

.5 Configuration Records; record of switch settings, program listings and parameter settings, after commissioning.

.6 Maintenance manuals.

.7 User guides, technical reference and programming manuals.

.8 CD-ROMs copies of:

.1 Manuals.

.2 Settings, databases and templates. Include both native format of files and ASCII-exported version.

.3 Application programs.

.9 Cable and software for use on The City's notebook computer for revising/downloading the settings and software.

.4 Maintenance Summary:

.1 Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.

.2 Format:

.1 Use Maintenance Summary Form bound with this section or electronic facsimile of such.

.2 Each Maintenance Summary may take as many pages as required.

.3 Use only 8-1/2-inch by 11-inch size paper.

.4 Complete using typewriter or electronic printing. Hand-written and hand-printed entries are will not be accepted.

.3 Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.

.4 Recommended Spare Parts:

.1 Data to be consistent with manufacturer's bill of materials/parts list furnished in O&M manuals.

.2 "Unit" is the unit of measure for ordering the part.

.3 "Quantity" is the number of units recommended.

.4 "Unit Cost" is the current purchase price.

1.7 Data For Materials and Finishes

.1 Content for Architectural Products, Applied Materials, and Finishes:

.1 Manufacturer's data, giving full information on products:

.1 Catalog number, size, and composition.

.2 Color and texture designations.

.3 Information required for reordering special-manufactured products.

.2 Instructions for Care and Maintenance:

.1 Manufacturer's recommendation for types of cleaning agents and methods.

.2 Cautions against cleaning agents and methods that are detrimental to product.

.3 Recommended schedule for cleaning and maintenance.

.2 Content for Moisture Protection and Weather Exposed Products:

.1 Manufacturer's data, giving full information on products:

.1 Applicable standards.

.2 Chemical composition.

.3 Details of installation.

.2 Instructions for inspection, maintenance, and repair.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

DEMONSTRATION AND TRAINING

1. GENERAL

1.1 Description

.1 This Section contains requirements for training the City staff, by persons retained by the Contractor specifically for the purpose of proper operation and maintenance of all equipment supplied and installed under this Contract.

.2 The Contractor shall develop the overall training plans for Unit Processes and Facility Areas with input from the Contractor Administrator, Manufacturers or vendors, and the City. The Contractor shall be responsible for providing qualified training instructors, classroom and field lesson plans as detailed in the Specifications and as described herein.

.3 The City provide a training location for the pre-purchased items listed in Appendix B, C, D and H for use by the Manufacturers' Representatives. The Contractor shall coordinate training sessions provided by the pre-purchased equipment Manufacturers' Representatives.

.4 Arrange for Manufacturers' Representatives to supply detailed classroom and hands-on training to the City's operations personnel, maintenance personnel, and select on-call personnel on operation and maintenance of specified product (system, subsystem, and component) and as may be required in applicable Specifications.

.5 The City will require training for at least three (3) shifts for each specified training session. Allow at least the minimum specified number of hours or days of training for each City staff shift for each specified product (system, subsystem, and component).

.6 To facilitate scheduling of the City personnel, the City may elect to divide sessions into operation-specific topics and maintenance-specific topics as applicable, to allow operations/ on-call staff and maintenance staff to attend separately. The Contractor shall coordinate with the Contract Administrator and the City.

.7 Training will be scheduled at least four (4) weeks in advance of the respective training sessions.

.8 Furnish trained, articulate personnel to coordinate and conduct training, to be present during training coordination meetings with the City and familiar with operation and maintenance manual information specified in Section 01 78 23 - Operation and Maintenance Data. Allow one training coordination meeting per equipment/system identified in Clause 1.6.

.9 Training sessions to be conducted by qualified Manufacturers' Representatives of the various equipment suppliers, with a minimum of two (2) years' experience. Manufacturers' Representatives shall be familiar with facility operation and maintenance requirements as well as with specified equipment.

.10 The Contract Administrator has the authority to determine if the training is sufficient based on the lesson plan submitted by the Contractor.

.11 Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

1.2 Submittals

.1 Submit the following information to the Contract Administrator thirty (30) days prior to the first training session. The material will be returned as either “NO EXCEPTIONS TAKEN”, “EXCEPTIONS NOTED” or “EXCEPTIONS NOTED - RESUBMIT”.

.1 Lesson plan and supplemental training manuals, handouts, visual aids and other reference material required for each training session.

.2 Submit proposed lesson plan not less than twenty-one (21) days prior to scheduled training and revise as necessary for acceptance.

.3 Lesson Plan: When training of the City personnel is specified, prepare for each required course, a lesson plan containing but not limited to the following information:

.1 Title and objectives.

.2 Recommended types of attendees (e.g., managers, engineers, operators, maintenance).

.3 Course description and outline of course content.

.4 Format (e.g., lecture, self-study, demonstration, hands-on).

.5 Instruction materials and equipment requirements, including supplemental training manuals, handouts, visual aids and other reference material required for each training session.

.6 Resumes of instructors providing the training.

.4 Training Schedule:

.1 Submit not less than twenty-one (21) calendar days prior to start of equipment installation and revise as necessary for acceptance.

.2 List specified equipment and systems that require training services and show:

.1 Respective manufacturer.

.2 Estimated dates for installation completion.

.3 Estimated training dates.

.3 Adjust schedule to ensure training of appropriate personnel as deemed necessary by the City, and to allow full participation by Manufacturers’ Representatives. Adjust schedule for interruptions in operability of equipment.

.4 Individual sessions shall not exceed four (4) hours. A break should be incorporated into sessions that exceed two (2) hours. Training session anticipated to exceed four (4) hours can be assigned to multiple-sessions; however, no more than one (1) – 3-hour and one (1) - 4-hour sessions (seven (7) hours total) may be delivered to the same participants in a single day. Two (2) successive 4-hour sessions may be

delivered to alternating shifts of attendees in a single day (i.e., one group of attendees in the morning, and a second group of attendees in the afternoon). Training sessions requiring more than seven (7) hours may be delivered on separate days.

.5 Classes shall not be scheduled concurrently.

1.3 Location and Training Facilities

.1 The City will provide the classroom training facilities.

.2 Field training sessions shall take place at the equipment location.

1.4 Format and Content

.1 The training sessions shall be comprised of both classroom training and field training. As a minimum, they shall cover the following topics for each item of equipment or system:

.1 Training will cover:

.1 Familiarization.

.2 Safety.

.3 Operation.

.4 Troubleshooting.

.5 Preventative and predictive maintenance.

.6 Corrective maintenance.

.7 Parts.

.8 Local representation.

.2 Classroom Training:

.1 As a minimum, classroom equipment/system training must be completed prior to Functional Testing and will include:

.1 The specific equipment location in the plant and operational overview. Use slides and drawings to aid discussion.

.2 Purpose and function of the equipment/system.

.3 The operating theory of the equipment/system.

.4 Start-up, shutdown, normal operation and emergency operating procedures, including system integration and electrical interlocks, if any.

.5 Safety items, standard operation procedures (SOPs), and safe work procedures (SWPs) related to operation of the equipment.

.6 Routine and preventative and predictive maintenance.

.7 Disassembly and assembly of equipment if applicable.

.8 Normal and major repair procedures.

.9 Inspection and troubleshooting procedures including the use applicable test instruments and the “pass” and “no pass” test instrument readings.

.10 Calibration procedures.

.2 The Contractor shall integrate a PCS Demonstration System into any classroom training course where:

.1 The content includes equipment monitoring and control via the HMI.

.2 The content includes alarming and alarm response.

.3 The content includes coordination of maintenance events and states to PCS/HMI status indications.

.4 The use of the PCS Demonstration System would clarify and/or aid in the training of the Training Participants.

.5 Where use of the PCS Demonstration System is included in a training course, the Contractor shall:

.1 Provide the PCS Demonstration System in accordance with the Specifications.

.2 Make certain that the PCS Demonstration System in no way impacts the actual operating PCS or in any other way expose the PCS to any risk of inadvertent operation.

.3 Provide a second projector and screen to display the HMI Operator Workstation to all participants.

.3 Field Training:

.1 As a minimum, field equipment training for operations personnel shall include:

.1 Identification of equipment: location of primary element; location of instrument readout; discussion on purpose, basic operation, and information interpretation.

.2 Discussion and demonstration of standard operating procedures, safe work procedure, and daily visual inspection of system operations.

.3 Discussion and demonstration of the preventative maintenance activities, and predictive maintenance activities where applicable.

.4 Discussion and demonstration of start-up and shutdown procedures.

.5 Demonstration of routine disassembly and assembly of equipment if applicable.

.6 Identification and review of safety items and demonstration of safety procedures, if feasible.

.7 Review of Contractor prepared Operation and Maintenance Manuals.

.8 Demonstration of operating parameter adjustment for optimized equipment/system operation.

1.5 Video Recording

.1 The Contractor shall notify all training providers that the training sessions will be videotaped.

.2 Supply video recording of instruction sessions, including manufacturers' representatives' hands-on equipment instruction and classroom sessions.

.3 Arrange for and carry the cost of videotaping one complete training session for each item of equipment and each system.

.4 The video record of training shall be provided in MPEG-4(.mp4) format. The digital file must be named with course title and reference to the training plan. The files shall be fully indexed and cataloged with file labels stating equipment or system, classroom or field session, and date recorded.

.5 Videotaping shall be by a professional commercial videographer, experienced in shooting training videos, in both good and inclement weather.

.6 Video Format and Quality:

.1 Digital (MPEG-4), with sound.

.2 Video:

.1 Produce bright, sharp, and clear images with accurate colors, free of distortion and other forms of picture imperfections.

.2 Electronically, and accurately display the month, day, year, and time of day of the recording.

.3 Audio:

.1 Audio recorded during documentation shall be done clearly, precisely, and at a moderate pace.

.7 Documentation:

.1 USB Stick Label:

.1 Video number (numbered sequentially, beginning with 001).

.2 Project Name.

.1 Facility name;

.2 Process area and equipment

.8 The digital files shall be fully indexed and cataloged with file labels stating equipment or system, classroom or field session, and date recorded.

.9 Acceptable videographer is McNeill Media Creations (Don McNeill, (204) 224-2578, mmc@shaw.ca) or approved equal in accordance with B7.

1.6 Equipment and Systems for Training

.1 Provide Training for the equipment and systems listed in the following table, and as otherwise Specified:

Equipment / System	**Specification Reference**	**Minimum Number of Person Days for Training, per Shift**
Overhead Coiling Door	08 33 23	1 person days
Process Electric Water and Eye Wash	22 05 15	2 person days
HVAC Fans	23 34 00	1 person days
Emergency Lighting System	26 52 13.13	1 person days
Instrumentation and Control for Process Systems	40 90 00	2 person days
Monorail Hoists	41 22 13	1 person day
Fire Alarm Systems	On Drawing	1 person day
Prepurchase Documents and Training (See Appendix for topics and length of training)		
UV System	Appendix	See Appendix B
Motor Control Center	Appendix	See Appendix C
Transformers	Appendix	See Appendix D
Gates	Appendix	See Appendix H

1.7 Training Completion Forms

.1 Form T-1 to be signed by the trainer, the Contract Administrator, and by a City Staff representative for each City shift when classroom training has been completed. One (1) form is to be used for each item of equipment and each system for which training has been provided. Once all classroom training sessions have been completed, Form T1 is to be submitted to the Contract Administrator.

.2 Form T-2 to be signed by the trainer, the Contract Administrator, and by a City Staff representative for each City shift when field training has been completed. One (1) form is to be used for each item of equipment and each system for which training has been provided.

Once all field training sessions have been completed, Form T2 is to be submitted to the Contract Administrator.

.3 The supply of adequate training, including completion of Forms T-1 and T-2 is a required prerequisite for handover of equipment, Unit Processes and Facility Areas as appropriate to the City.

1.8 Supplement

.1 Supplements listed below, following "End of Section," is a part of this Specification:

.1 Form T-1 Certificate of Satisfactory Classroom Training.

.2 Form T-2 Certificate of Satisfactory Field Training.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CERTIFICATE OF SATISFACTORY CLASSROOM TRAINING
FORM T1

We certify that the initial training for the equipment listed below has been provided as per the Specifications.

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Trainer) Date

_____ _____
(City Staff Representative) Date

_____ _____
(Contract Administrator) Date

CERTIFICATE OF SATISFACTORY FIELD TRAINING
FORM T2

We certify that the final training for the equipment listed below has been provided as per the Specifications.

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Trainer) Date

_____ _____
(City Staff Representative) Date

_____ _____
(Contract Administrator) Date

COMMISSIONING PLAN

1. GENERAL

1.1 Description

.1 Provide a complete and fully functional system ensuring that:

.1 City personnel have been fully trained in all aspects of installed systems as described in Section 01 79 00 – Demonstration and Training.

.2 Final O&M Manuals have been submitted and accepted.

.2 The Contractor shall develop a Detailed Commissioning Plan and Commissioning Schedule using this Section as a Base Commissioning Plan.

.3 Use this Section as a master planning document for Commissioning as it:

.1 Outlines organization, scheduling, allocation of resources, and documentation pertaining to implementation of Commissioning.

.2 Communicates responsibilities of team members involved in Commissioning including scheduling, documentation requirements, and verification procedures.

.3 Sets out deliverables relating to operation, maintenance, process and administration of Commissioning.

.4 Describes how the process of verification meets the design requirements of the completed Works.

.5 Sets out scope, standards, roles and responsibilities, expectations, deliverables and provides:

.1 An overview of Commissioning.

.2 A general description of elements that make up the Detailed Commissioning Plan.

.3 A process and methodology for successful Commissioning.

.4 Ensure the system is also functioning as described in Section 40 61 96 - Process Control Description.

.5 The Contract Administrator shall witness and certify tests and reports of results.

.6 Commissioning activities must be completed before issuance of Substantial Performance.

1.2 Definitions

.1 Acceptance: for the purpose of this Specification Section, acceptance shall be defined as the formal turnover of a system to the City. This shall occur after the successful end of Commissioning of each system through a formal acknowledgement between the Contract Administrator, the City, and the Contractor. Success of the Commissioning period is determined by the Contract Administrator.

.2 Base Commissioning Plan: General Commissioning requirements within this Section to be used in the development of a Detailed Commissioning Plan.

.3 Bumping:

.1 Used to Commission mechanical systems and associated equipment.

.2 Used to Commission, test, and tune instrumentation and process loops.

.4 Architectural and structural systems:

.1 Doors, windows, related hardware.

.2 Overhead doors.

.5 Process systems:

.1 UV System.

.2 Process piping, gates and operators.

.3 Instrumentation and control systems.

.6 Plumbing systems:

.1 Domestic CWS and HWS.

.2 Emergency shower/eyewash systems.

.3 Trap primers for floor drains.

.7 Heating, ventilation and air conditioning (HVAC) and exhaust systems:

.1 HVAC systems.

.2 Exhaust systems and related systems.

.3 Ventilation system for UV Channels.

.8 Transformers.

.9 Low voltage below 750 V:

.1 Low voltage equipment.

.2 Low voltage distribution systems.

.3 Electronic data and communications information systems.

.4 Security systems.

.5 Lighting systems.

.6 Lighting equipment.

.7 Distribution systems.

.10 Fire alarm systems, equipment:

.1 Fire Extinguisher.

.2 Fire alarm.

.11 Instrumentation and control systems:

.1 PLC automation system.

.2 Instrumentation.

.3 Communication with the Plant's Process Control System.

.12 Commissioning: for the purpose of this Specification Section, Commissioning shall be defined as the successful operation of components, equipment, systems, subsystems, or integrated systems in accordance with its design requirements for a period of thirty (30) days, the last seven (7) of which shall be consecutive, unless otherwise specified.

.13 Commissioning Agent: Agent of the Contractor with minimum ten (10) years of experience in Commissioning, satisfactory to the Contract Administrator, responsible for the oversight and execution of Commissioning.

.14 Commissioning Report: the final Commissioning document as described in Item 3.14.

.15 Commissioning Schedule: Gantt chart showing planned dates for performing all activities related to commissioning of all upgraded systems. The Commissioning Schedule is to be developed by the Contractor and submitted to the Contract Administrator for review, as described in Item 3.1.

.16 Demonstration: a one-hour demonstration of the successful installation and operation of the equipment.

.17 Detailed Commissioning Plan: Commissioning Plan developed by Contractor from the Base Commissioning Plan to be submitted and reviewed by the Contract Administrator, as described in Item 3.2. Unless defined as "Base Commissioning Plan", all other instances of "Commissioning Plan" refer to the Detailed Commissioning Plan.

.18 The Detailed Commissioning Plan shall contain three (3) distinct commissioning plans; one (1) for each UV channel. Upon successful completion of commissioning for each channel, full-system commissioning is required once all three channels are brought online. The software program and the PCS program will need to be staged as the I/O for the equipment is brought online. The pre-purchased equipment supplier is to participate in development of all commissioning plans.

.19 Running Test: a test in which equipment is run continuously for a minimum of seven (7) days or as specified for different equipment. During this period, as practicable, conditions shall be simulated which represent maximum or most severe, average, and minimum or least severe

conditions. Successful completion of the Running Test is required for Form 103. In the event that the conditions cannot be simulated by modifying plant operations, the I/O signals may be manipulated to simulate the conditions to verify necessary response by the UV system.

.20 Performance Test: a test in which the equipment is run continuously for thirty (30) days after the complete UV system has been installed. During this period, as practicable, conditions shall be simulated which represent maximum or most severe, average, and minimum or least severe conditions. Successful completion of the Performance Test is required for Form 104.

.21 System: for the purpose of this Specification section, a system shall be defined as the equipment, piping, controls, ancillary devices, electrical power, etc., which together perform a specific function at the facility.

1.3 Submittals

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

.2 Commissioning Schedule to be submitted and accepted by the Contract Administer as per Item 3.1.

.3 Detailed Commissioning Plan to be submitted and accepted by the Contract Administer as per Item 3.2.

.4 Detailed Commissioning Plan to be refined and resubmitted as required during the construction phase as per Item 3.3.

1.4 Composition, Roles, and Responsibilities of Commissioning Team

.1 Commissioning Team to consist of the following members:

.1 Contract Administrator who is responsible for:

.1 Monitoring Commissioning activities.

.2 Witnessing and certifying reported results.

.3 Reviewing and approving Contractor submissions.

.4 Assisting in the resolution of issues resulting from all tests.

.5 Reviewing the final Commissioning Report.

.2 City personnel who are responsible for:

.1 Attending Commissioning activities to verify re-installed existing equipment operates as per the original sequence of operations.

.2 Attending Commissioning activities to verify newly installed equipment operates as intended.

.3 Performing necessary testing as noted in Item 3.11.

.3 Construction Team: Contractor, Subcontractors, suppliers, and support disciplines, who are responsible for construction/installation in accordance with Contract Documents, including:

.1 Testing.

.2 Mechanical testing, adjusting and balancing (TAB).

.3 Integrating Commissioning activities into the Contractor's Project Schedule (Project Schedule).

.4 Performing and documenting equipment installation as per Section 01 65 00 - Equipment Installation.

.5 Performing and documenting start-up including installation/start-up checklists.

.4 Contractor's Commissioning Agent who is responsible for implementing specified Commissioning activities including:

.1 Planning/preparing checklists (installation/start-up checklists as required, product information) and test procedures.

.2 Determining operational training requirements.

.3 Developing a Detailed Commissioning Plan, updating information provided in the Base Commissioning Plan.

.4 Performing and documenting Running Testing and Performance Testing.

.5 Preparing and updating issues logs.

.6 Verifying, reviewing, and conducting training.

.7 Preparing final Commissioning Report.

1.5 Extent of Commissioning

.1 Testing of electrical panels and transformers must be completed before proceeding with Commissioning activities.

.1 Testing after the electrical modifications shall conform to CSA C22.2 No. 14, CSA C22.2 No. 286 and related CSA standards. CSA special inspections shall be coordinated by the Contractor after operation is confirmed.

.2 Commission mechanical systems and associated equipment:

.3 Process systems:

.1 UV System.

.2 Process piping, gates and operators.

.3 Instrumentation and control systems.

.4 Plumbing systems:

.1 Domestic CWS and HWS.

.2 Emergency shower/eyewash systems.

.3 Trap primers for floor drains.

.5 Heating, ventilation and air conditioning (HVAC) and exhaust systems:

.1 HVAC systems.

.2 Exhaust systems and related systems.

.3 UV channel ventilation.

.6 Low voltage below 750 V:

.1 Low voltage equipment.

.2 Low voltage distribution systems.

.3 Electronic data and communications information systems.

.4 Security systems.

.5 Lighting systems.

.6 Lighting equipment.

.7 Distribution systems.

.7 Fire alarm systems, equipment:

.1 Fire Extinguisher.

.2 Fire Alarm

.8 Instrumentation and control systems:

.1 PLC automation system.

.2 Instrumentation.

2. PRODUCTS

2.1 Equipment

.1 Provide sufficient instrumentation to verify and commission the installed systems.

3. EXECUTION

3.1 Commissioning Schedule

.1 Prepare a detailed Commissioning Schedule and submit to the Contract Administrator for review and approval at the same time as the Project Schedule. Include milestones, testing, documentation, training, and Commissioning activities of components, equipment, subsystems, systems, and integrated systems.

.2 After approval, incorporate the Commissioning Schedule into the Project Schedule.

.3 Contractor, Contractor's Commissioning Agent, and Contract Administrator will monitor progress of Commissioning against the approved Commissioning Schedule.

3.2 Development of Commissioning Plan

.1 This Section is to be considered a Base Commissioning Plan for the UV System, to be used by the Contractor in the development of a Detailed Commissioning Plan.

.2 The Detailed Commissioning Plan and associated Commissioning Schedule is to be approved by the Contract Administrator at least twenty (20) Business days prior to the planned start of Commissioning. The plan shall comply with the requirements that have been established by the Contract Administrator.

.3 The Detailed Commissioning Plan shall be drafted by the Contractor and reviewed by the Contract Administrator and shall incorporate the contents of the Base Commissioning Plan as specified in this Section. The Detailed Commissioning Plan shall include the following:

.1 A detailed schedule of Commissioning events to be incorporated into the Project Schedule, including but not limited to, the schedule for completion of testing of all component parts of the system.

.2 A sampling and analytical program for tests necessary to verify compliance with the performance specifications.

.3 Inform the Contract Administrator at least fifteen (15) Business Days in advance of conducting the tests and arrange for the attendance of the Manufacturer’s Representative. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Contractor and the Contract Administrator.

.4 The Manufacturer’s Representative shall conduct all necessary checks to the equipment and if necessary, advise the Contractor of any further checking, flushing, cleaning, or other work needed prior to confirming the equipment is ready to run.

.5 Contingency plans in the event of a process malfunction.

.6 Drawings and sketches as required to illustrate the planned sequence of events.

.7 List and details for all temporary equipment or component (additional lamps, etc.) required to facilitate Commissioning.

.8 List of all personnel who the Contractor plans to be in attendance for Commissioning and handover with information indicating their qualifications for this Work.

.4 The Detailed Commissioning Plan to take into account:

.1 Approved Shop Drawings and product data.

.2 Approved changes to the Contract.

.3 Project Schedule.

.4 Contractor's, Subcontractor's, and suppliers' requirements.

.5 Project construction team's and Commissioning team's requirements.

.5 The Detailed Commissioning Plan to include:

.1 Commissioning Schedule.

.2 Installation/start-up check lists provided by manufacturers and suppliers.

.3 Manufacturer Performance Testing forms provided by manufacturers and suppliers.

.1 Forms to include testing parameters at full range of operating conditions to verify responses of equipment and systems.

.6 Submit the completed Detailed Commissioning Plan to the Contract Administrator for review and acceptance. The Detailed Commissioning Plan shall be reviewed prior to its implementation. The Contract Administrator shall be the final arbiter.

3.3 Refinement of Commissioning Plan

.1 During the construction phase, revise, refine, and update the Detailed Commissioning Plan to include approved design and construction changes.

.1 At each revision, indicate revision number and date.

.2 Submit each revised Detailed Commissioning Plan to the Contract Administrator for review and acceptance.

3.4 Equipment

.1 All process, electrical, control, and miscellaneous equipment related to the system shall be successfully installed and tested in accordance with Section 01 65 00, this Section, and any specific requirements noted in other Divisions. Form 103 and Form 104 shall be executed for each piece of major equipment.

.2 Temporary equipment or components will be installed and tested as necessary to ensure that it functions reliably and consistently through the Commissioning period.

3.5 Controls

.1 All controls which are the responsibility of this Contractor shall be installed and tested prior to Commissioning.

.2 The Contractor shall arrange for the simulation of the control sequences at the discretion of Contract Administrator. Every effort shall be made to ensure that the Commissioning period provides for the full and comprehensive operation of the equipment under all anticipated normal and adverse operating conditions.

.3 In the event that achieving adverse operating condition was deemed impractical by the City operation, the I/O signals may be manipulated to achieve the necessary reaction of the system.

3.6 Plant Utility Service

.1 The City will provide power and other ancillary services as necessary to operate the facility through the Commissioning period. Provision of these services shall be limited to reasonable levels.

3.7 Manpower

.1 Supply all staff required during Commissioning as necessary to assist the City's staff in the operation of the facility.

.2 Supply competent staff capable of maintaining, repairing, and adjusting the equipment and controls to achieve the intended design functions during the Commissioning period.

.3 Ensure equipment Manufacturer's Representatives are on Site to certify adjustments in equipment, to guide in setting correct operating limits, and to generally provide input as required for the appropriate operation of the equipment.

3.8 Operating Descriptions

.1 Operating descriptions shall be prepared by the Contract Administrator for the facility systems. Other information outlining the operating requirements shall also be available from the Contract Administrator. The Contractor will review these descriptions and will make themselves familiar with the requirements in order that they can undertake Commissioning in an appropriate manner.

.1 Operating descriptions shall be considered part of documentation for systems as listed in Item 3.14.2.

3.9 Design Parameters

.1 Design parameters for the system to be commissioned shall be as defined in the Specifications and/or the operating descriptions.

3.10 Pre-Commissioning Activities

.1 Conduct pre-start-up pressure, static, flushing, cleaning, "bumping" testing, and loop validation during construction as specified in the individual sections. This testing to be witnessed and

certified by the Contract Administrator and does not form part of Commissioning specifications. Include completed documentation with the Final Commissioning Report.

.2 Perform prestart up inspections prior to commencing Commissioning. Utilise approved installation/start-up check lists if required. Rectify any deficiencies to the Contract Administrator's satisfaction. Include completed documentation with the Final Commissioning Report.

.3 Pre-commissioning activities shall include, at minimum:

.1 Plumbing and process systems:

.1 "Bump" each item of equipment in its "stand-alone" mode.

.2 Complete pre-start-up checks and complete relevant documentation.

.3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.

.2 HVAC equipment and systems:

.1 "Bump" each item of equipment in its "stand-alone" mode.

.2 At this time, complete pre-start-up checks and complete relevant documentation.

.3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.

.4 Perform TAB on systems. TAB reports to be approved by the Contract Administrator.

.4 Electrical:

.1 Transfer switches.

.2 Power systems.

.3 Lighting systems.

3.11 Tests to be Performed by City

.1 City staff may conduct additional sampling for microbiological and/or chemical analysis at their own discretion to supplement testing required by the Contractor as part of this Work.

3.12 Commissioning of Instrumentation and Control

.1 Commissioning activities shall only proceed after instrumentation and control tests have been completed. Refer to Division 26 and Division 40 for additional requirements and test forms.

.2 A minimum written notice of two (2) weeks is required prior to commencing with process commissioning activities. In order to qualify for process commissioning the following activities must be completed:

.1 Instrument Calibrations;

.2 Initial Control Settings and adjustments have been made;

.3 All field devices have been set-up;

.4 Forms (i.e., Form 100, Form 101, etc.; signed off where required) have been completed;

.5 PLC/SCADA IO and loop checks have been completed; and

.6 Proper mounting and connections have been made.

.3 During Commissioning, demonstrate to the Contract Administrator proper field calibration and correct operation of instruments and gauges.

.4 Commissioning of the instrumentation and control system to include but not be limited to the following:

.1 Verify installation of components, wiring connections, and piping connections.

.2 Verify wiring continuity and pipe leak tests.

.3 Verify instrument calibrations and loop tests and provide a written report to the Contract Administrator.

.1 The report shall include record of functional checks and any adjustments required for the instruments and control equipment under operational conditions.

.4 Coordinate instruments and control equipment supplier's service personnel as required for complete system testing.

.5 Coordinate and cooperate with the City, Contract Administrator, and other contractors to commission the Control System I/O points.

.6 Direct plant personnel at hand-over as to final adjustment of the system for correct operation of plant.

.7 Ensure that the instrumentation and control equipment suppliers cooperate to complete the Work.

.8 Verify signal levels and wiring connections to all instrumentation and control equipment.

3.13 Start-Up and Commissioning of Process Equipment

.1 A Manufacturer’s Representative shall conduct all necessary checks to the equipment prior to start-up as described in Section 01 65 00 - Equipment Installation.

.2 Following the installation and calibration of the equipment, the Contractor shall perform a Demonstration, Running Test, and Performance Test of the full system. It will be the responsibility of the Contractor to communicate to arrange the times for testing and start-up activities. The Contractor must confirm that these times are acceptable to the Contract Administrator and the City.

.1 During the Demonstration, Running, and Performance tests, the Contractor shall operate equipment as required to meet the requirements from all Divisions of this Specification.

.2 If required, the Contractor shall supply any ancillary equipment or services required to complete the initial Demonstration, Running Test, and Performance Tests.

.3 Should the initial Demonstration, Running Test, or Performance Tests reveal any defects, then those defects shall be promptly rectified and the Demonstration, Running Tests, and/or Performance Tests shall be repeated to the satisfaction of the Contract Administrator. Even if this shall require repeating of all commission procedures from the beginning, it will be at the dole discretion of the Contract Administrator.

.4 Additional costs incurred by the Contractor due to repeat Demonstration, Running Tests, and/or Performance Tests shall be borne by the Contractor.

.3 On successful completion of the Demonstration and Running Test, Form 103 – Certificate of Equipment Satisfactory Running Test Performance (Form 103) (attached to this Specification) will be signed by the Manufacturer's Representative, the Contractor, and the Contract Administrator. Form 103 is required for each channel and each piece of major equipment, which includes its associated electrical/control modifications by extension.

.4 On successful completion of the Performance Test, Form 104 – Certificate of Equipment Satisfactory Performance Test Performance (Form 104) (attached to this Specification) will be signed by the Manufacturer's Representative, the Contractor, and the Contract Administrator. Form 104 is required for each piece of major equipment, which includes its associated electrical/control modifications by extension. For clarity, Performance Testing will not begin until all UV equipment is installed.

.5 Demonstration:

.1 The Contractor shall notify the Contract Administrator of their readiness to demonstrate the operation of the equipment. The Contract Administrator shall attend.

.2 With the assistance of the Manufacturer's Representative, the Contractor shall demonstrate that the equipment is properly installed. Alignment, piping connections, electrical connections, etc. will be checked and if appropriate, code certifications provided.

.3 The equipment shall then be run for one (1) hour. Local controls shall be verified by cycling the equipment through several start-stop operations, modulating its output, or some combination. Operating parameters will be checked to ensure that they are within the specified or Manufacturer's Representative's recommended limits, whichever is more stringent. This step shall be repeated for each modified system.

.4 On satisfactory completion of the one (1) hour demonstration, the equipment shall be stopped and critical parameters shall be rechecked.

.6 Running Test:

.1 The Running Test shall be performed subsequent to modification and successful Demonstration of equipment.

.2 After cleaning, completely test each UV bank to verify that equipment can perform its specified function in satisfactory manner without mechanical or electrical defects, or operational difficulties.

.3 The equipment shall be restarted and run continuously for a minimum of seven (7) days or as specified. During this period, as practicable, conditions shall be simulated which represent maximum (or most severe), average, and minimum (or least severe) conditions. These conditions will be mutually agreed to by the Manufacturer's Representative, the Contractor, and the Contract Administrator on the basis of the information contained in the technical specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.

.4 Running Test shall be repeated for each piece of major equipment (and each channel separately).

.5 The Contractor shall conduct daily E.coli sampling throughout the Running Test:

.1 Contractor shall collect and send final effluent samples to an accredited laboratory for analysis of E.coli, UV transmittance (%UVT) and total suspended solids (TSS) concentrations at their own cost.

.2 The grab samples shall be collected for each day that the UV system is discharging effluent to the outfall (one (1) sample set per day).

.3 Each set of samples shall include the following analyses:

.1 The most probable number (MPN) Fecal Coliform count per 100 mL in the UV disinfection channel influent (upstream) and effluent (downstream).

.2 The %UVT at a wavelength of 254 nanometers of the UV disinfection channel influent.

.3 The TSS concentration in the UV disinfection channel influent.

.4 Collect adequate sample such that the City may split the sample and perform its own testing, at its discretion.

.5 Running Test shall demonstrate that the UV system meets the E.coli limits.

.6 The criterion for a Running Test pass shall be E.coli count of less than 200 MPN/100 ml for all effluent UV samples based on a 7-day Geometric Mean over the 7 day period.

.6 The Running Test shall be completed as follows:

.1 To perform the Running Test, the Contractor, with supervision by the Manufacturer's Representative, shall operate all controls and other devices to ensure they are functional.

.2 The purpose of the Running Test shall be to demonstrate the effectiveness of all system components and control features in all modes of control.

.1 Local control of all devices when local controllers and/or HMI are not in service.

.2 Automatic shutoff and alarm for various failure modes. This includes air monitoring, process monitoring, and shutdown sequences are operating as intended for both life safety and process safety.

.3 Automatic switchover from normal power to emergency power, and emergency power to normal power, if this function has been disturbed by modifications.

.4 Operation of mechanical cleaning system and chemical cleaning system where applicable.

.5 Operation of all monitoring instruments.

.6 All control functions, both at local system, HMI, and SCADA OIT(s).

.7 At the time of the tests, make final adjustments necessary to place equipment in satisfactory working order to prepare for Start-up.

.8 Test and calibrate equipment and accessories specified herein in accordance with Supplier's printed instructions over full operating range of equipment.

.9 The Contractor shall submit results of the Running Test within twenty-four (24) hours to the Contract Administrator. Final documented and summarized results shall be submitted in a format acceptable to the Contract Administrator within five (5) Business days. Results shall include, at a minimum:

.1 Pass or Fail status of all tasks and commentary on the performance of each task.

.2 The headloss through each UV channel at peak flow.

.3 The average power draw of the UV system.

.4 The peak power draw of the UV system.

.10 The Contractor, with assistance from the Manufacturer's Representative, shall complete the Running Test to the satisfaction of the Contract Administrator and the City prior to commencing the Performance Test.

.7 Performance Tests:

.1 Following completion of the Demonstration and Running Tests, the Contractor in cooperation with the City's operating staff shall conduct the Performance Test with supervision assistance from the Manufacturer's Representative. The Manufacturer's Representative shall submit to the Contractor, the City, and the Contract Administrator a complete testing plan.

.2 Performance Tests shall be conducted subsequent to the Running Test.

.3 A Performance Test shall be restarted if a critical failure occurs. A critical failure shall be deemed as a failure which prohibits the process from functioning successfully or which creates a safety hazard.

.4 To perform the Performance Test, the Contractor in cooperation with City's operating staff shall operate the complete system with on-site supervision assistance from the Manufacturer's Representative continuously for a minimum of thirty (30) days and collect and summarize data to demonstrate that the system meets the requirements.

.5 During the thirty (30) day period, conditions shall be simulated by plant operations which represent maximum (or most severe), average, and minimum (or least severe) flow and UVT conditions. These conditions shall be mutually agreed to by the Supplier's Representative, the Contractor, and the Contract Administrator on the basis of the information contained in the technical specifications, and the methods utilized to create the simulated conditions and the time periods allotted to each.

.6 The Performance Test shall be completed for the entire UV system.

.7 Performance Tests shall be as dictated in this Section, the technical specifications for each piece of equipment, and as reasonably required by the Contract Administrator to prove adherence to the requirements listed in the Appendix B.

.8 The UV system shall be run in automatic mode and respond to varying flow, UV transmittance, and UV intensity signals.

.9 At the completion of the Performance Test, confirm all instruments remain within calibration tolerances. If out of calibration, take necessary actions to rectify the instruments and recalibrate.

.10 The Contractor shall supply all water, UV feed, chemicals, temporary power, heating, and/or any other ancillary equipment or services required to complete the initial demonstration, running test and performance tests.

.11 Should the initial demonstrations, Running Tests or the Performance Test reveal any defects, then those defects shall be promptly rectified and the demonstration, Running Tests and/or the Performance Test shall be repeated to the satisfaction of the Contract Administrator. Additional costs incurred by the Contractor, or the Contract Administrator, due to repeat demonstration, running tests, and/or performance tests shall be the responsibility of the Contractor.

.12 Contractor shall collect and send final effluent samples for each newly equipped channel to an accredited laboratory at their own cost for analysis of E. coli, %UVT and TSS concentrations.

.13 Samples shall be collected daily for the entirety of the thirty (30) day Performance Test.

.14 Each set of samples shall include the following analyses:

.1 The most probable number (MPN) Fecal Coliform count per 100 mL in the UV disinfection channel influent (upstream) and effluent (downstream).

.2 The %UVT at a wavelength of 254 nanometers of the UV disinfection channel influent.

.3 The TSS concentration in the UV disinfection channel influent.

.15 Performance Test shall demonstrate that the UV system meets monthly E.coli limits.

.16 The criterion for a Performance Test pass shall be E.coli count of less than 200 MPN/100 ml for all effluent UV samples based on a 30-day Geometric Mean.

.17 If, in the opinion of the Contract Administrator, the system does not meet the requirements specified in Section 46 21 00.

.18 The Contractor shall submit the initial results of each Performance Test within twenty-four (24) hours to the Contract Administrator. Final documented and summarized results shall be submitted in a format acceptable to the Contract Administrator within five (5) Business days.

.19 The Contract Administrator reserves the right to request additional testing at no additional cost. No equipment shall be accepted and handed over to the City prior to the satisfactory completion of the Performance Tests and receipt of the test reports.

.20 In all cases, compliance with the requirements of this Specification shall be determined for each day of the testing period.

.21 The Manufacturer's Representative shall be responsible for confirming instruments are within the accuracy tolerances required for system operation and performance.

.22 Should the Manufacturer's Representative be off-Site during the Performance Test, the Manufacturer's Representative is to provide full technical supervision (24/7) with telephone support and performance monitoring.

.23 During the Performance Test, the City shall have the option of collecting samples for independent analyses to confirm measurements and analyses conducted by the Manufacturer's Representative and the Contractor. The Contract Administrator and the City shall have the option of witnessing all testing performed by the Manufacturer's Representative and the Contractor.

.24 At the end of the Performance Test, confirm that the equipment is still within calibration. If calibration exceeds the manufactures acceptable requirements, address the issue and extend performance testing by seven (7) days.

.25 The Manufacturer's Representative and the Contractor shall provide the Performance Test Report within five (5) Business days of completion of the Performance Test.

.1 The Performance Test Report shall include the following as a minimum:

.1 Performance Test conditions and procedures.

.2 Corrective actions taken.

.3 Retesting results (if necessary).

.4 Other pertinent information (if any).

.5 Conclusions.

.6 Recommendations for future actions.

3.14 Final Commissioning Report

.1 Contractor to submit the completed Commissioning Report within a maximum of two (2) weeks of completion of Commissioning. The final Commissioning Report is to be reviewed and accepted by the Contract Administrator prior to granting Substantial Performance.

.2 Final Commissioning Report to include:

.1 Start-up, pre- Commissioning activities, and documentation for systems and equipment.

.2 Description of Commissioning activities and documentation.

.3 Description of Commissioning of integrated systems and documentation.

.4 Completed installation checklists if required by manufacturer.

.5 Completed Running and Performance Test Report(s).

.6 Final settings of commissioned equipment.

.7 Training Plans.

.3 Before the final Commissioning Report is accepted, individual reported results to be subject to verification by the Contract Administrator.

3.15 Training Plans

.1 Refer to Section 01 79 00 - Demonstration and Training.

3.16 Supplements

.1 The supplements listed below, following “End of Section”, are part of this Specification:

.2 Form 103 – Certificate of Equipment Satisfactory Running Test Performance.

.3 Form 104 – Certificate of Equipment Satisfactory Performance Test Performance.

END OF SECTION

CERTIFICATE OF EQUIPMENT SATISFACTORY PERFORMANCE RUNNING TEST FORM 103

We certify that the equipment listed below has been operated and tested as per the Specifications using water and that the equipment meets its Running Testing criteria. No defects in the equipment were found. The equipment is therefore classed as “conforming”.

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Contractor) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

Acknowledgement of Receipt of O&M Manuals.

_____ _____
(Authorized Signing Representative of the City) Date

CERTIFICATE OF SATISFACTORY PERFORMANCE TEST PERFORMANCE FORM 104

We certify that the equipment listed below has been operated and tested as per the Specifications using water and that the equipment meets its Performance Testing criteria. No defects in the equipment were found. The equipment is therefore classed as “conforming”.

PROJECT: _____

SYSTEM DESCRIPTION: _____

_____

TAG NO (S): _____

REFERENCE SPECIFICATION (S): _____

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Contractor) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

_____ _____
(Authorized Signing Representative of the City) Date

DEMOLITION FOR MINOR WORKS

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA International):

.1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

1.2 Waste Management and Disposal

.1 The Contractor is to divert waste material from landfill sites to the extent possible.

.2 Contractor shall dispose of waste material in the following manner and order:

.1 Sell waste material for reuse or recycling. If not feasible, then:

.1 Donate waste material for reuse or recycling to the Restore-Habitat for Humanity or other non-profit organization. If not feasible, then:

.1 Legally dispose of waste material at nearest landfill site.

1.3 Storage, Handling and Protection

.1 Store, materials to be reused, recycled and salvaged in locations as directed by Contract Administrator.

.2 Unless specified otherwise, materials for removal become Contractor's property.

.3 Protect, stockpile, store and catalogue salvaged items.

.4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility (if not scheduled for reuse or recycling).

.5 Protect structural components not removed for demolition from movement or damage.

.6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Contract Administrator.

.7 Protect surface drainage, mechanical and electrical from damage and blockage.

.8 Separate and store materials produced during dismantling of structures in designated areas.

1.4 Disposal of Wastes

.1 Do not bury rubbish or waste materials.

.2 Do not dispose of waste, volatile materials, mineral spirits, oil, or paint thinner into waterways, storm, or sanitary sewers.

1.5 Site Conditions

.1 Refer to Section 01 41 00 - Regulatory Requirements.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Preparation

.1 Inspect building and Site with Contract Administrator and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.2 Contractor to provide equipment that has been removed from the construction Site that the City would like to salvage. The Contractor is to make an effort to remove these items carefully and provide them to the City, if possible.

.3 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.4 Notify and obtain approval of utility companies before starting demolition.

.5 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the Work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the Site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

.1 Immediately notify Contract Administrator and utility company concerned in case of damage to any utility or service, designated to remain in place.

.2 Immediately notify the Contract Administrator should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 Protection

.1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features and parts of building to remain in place. Provide bracing and shoring required.

.2 Keep noise, dust, and inconvenience to occupants to minimum.

.3 Protect building systems, services and equipment.

.4 Provide temporary dust screens, covers, railings, supports and other protection as required.

3.3 Salvage

.1 Refer to demolition drawings and Specifications for items to be salvaged for reuse.

.2 Remove items to be reused, store as directed by Contract Administrator, and re-install under appropriate section of Specification.

3.4 Demolition

.1 Remove parts of existing building to permit new construction. Sort materials into appropriate piles for reuse and recycling.

.2 Trim edges of partially demolished building elements to tolerances as defined by Contract Administrator to suit future use.

3.5 Repair Materials

.1 Use repair materials identical to existing materials:

.1 If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

.2 Use materials whose installed performance equals or surpasses that of existing materials.

.3 Comply with material and installation requirements specified in individual Specification Sections.

3.6 Disposal

.1 Dispose of removed materials to appropriate recycling facilities or reuse facilities, or legally dispose materials at nearest landfill site.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Engineering design for formwork.

.2 Wood and/or steel forms for all cast-in-place concrete, shoring, bracing, and anchorage.

.3 Form openings for other trades.

.4 Coordinate installation of concrete accessories.

.5 Set anchor rods, anchors, sleeves, frames, and other items supplied by other Division within Contract.

.6 Clean erected formwork prior to concrete placement.

.7 Remove forms and supporting falsework.

.8 Void forms between structural elements and the soil below where indicated.

.9 Reshoring.

1.2 Design Standards

.1 Design and detail forms and supporting falsework in accordance with the latest edition of NBC of Canada with the Manitoba amendment, and the current editions of CSA A23.1, CSA S269.1, CAN/CSA-S269.3, ACI 347, ACI 347.2R, and applicable construction safety regulations.

.2 Design of the formwork, falsework, and reshoring shall be performed by a Professional Engineer registered in the Province of Manitoba. The Contractor's Engineer doing the design shall review the in-place formwork, falsework and reshoring and certify in writing that the Work is in conformance with her/his design.

1.3 Quality Assurance

.1 Construct and erect concrete formwork in accordance with CSA A23.1, CSA-S269.3, ACI 347, ACI 347.2R and all applicable construction safety regulations for the place of Work.

1.4 Shop Drawings

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

.2 Clearly indicate sizes, methods of construction, materials, arrangement of joints, ties and shores, location and size of falsework, schedule of erection and stripping, reshoring, etc.

.3 Shop Drawings and design briefs are to bear the seal of a Professional Engineer registered in the Province of Manitoba.

.1 The Shop Drawings shall indicate the Contractor proposed construction joint locations and concrete casting sequence.

.2 Adjust the Contractor proposed construction joints as directed by the Contract Administrator at no additional cost to the City.

.4 Formwork, falsework, and reshoring are to be reviewed prior to each concrete casting by the same Professional Engineer who sealed the Shop Drawings.

.5 The Contractor's Professional Engineer is to report, in writing to the Contract Administrator that reviewed formwork, falsework, and reshoring are in accordance with the design, prior to each concrete casting.

2. PRODUCTS

2.1 Exposed Surfaces

.1 Square-edged, smooth-surfaced panels true in plane, free of holes, surface markings, or defects.

2.2 Unexposed Surfaces

.1 Square-edged tongue and groove lumber, plywood or other material, suitable to retain concrete without leakage or distortion.

2.3 Wood Materials

.1 Plywood: Douglas fir, conforming to CSA O121 solid one side, sheathing grade. Sound undamaged sheets with clean true edges.

.2 Lumber: conforming to CAN/CSA-O141.

.3 Nails, spikes, and staples: galvanized; in accordance with CSA O86.

2.4 Prefabricated Forms

.1 Steel type: minimum 1.6 mm steel thickness; well matched, tight fitting and adequately stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished concrete surface.

.2 Void forms: the void form shall leave a complete void below the structural element for the full depth indicated on the Drawings. Acceptable product is:

.1 Moisture-resistant treated paper faces; bio-degradable, structurally sufficient to support weight of wet concrete mix and construction loads until initial concrete set.

2.5 Accessories

.1 Form ties: removable snap-off metal type, fixed length, minimum working strength of 13 kN when assembled; free of defects that will leave holes deeper than 25 mm from concrete surface. Use plastic cone snap type or screw type on exposed surfaces. Wire ties are not permitted.

.2 Form release agent: colourless mineral oil that will not stain concrete or impair natural bonding or colour characteristics of coating intended for use on concrete.

.3 Corner or chamfer fillets: mill finished pine, 25 mm width, maximum possible lengths, mitre ends.

.4 Sealing tape: reinforced, self-adhesive, waterproof Kraft.

.5 Galvanizing for steel nails and fasteners: conforming to ASTM A-153/A-153M.

3. EXECUTION

3.1 Examination

.1 Before starting this Work, examine all Work done by others that affects this Work.

.2 Notify the Contract Administrator of any conditions that would prejudice proper completion of this Work.

.3 Prior to the erection of the formwork, all construction joints in the immediate area shall be sand blasted and cleaned in accordance with Section 03 30 00 – Cast-in-Place Concrete.

.4 Commencement of the Work implies acceptance of existing conditions.

3.2 Erection

.1 Verify lines, levels, and centers before proceeding with formwork. Ensure dimensions agree with Drawings.

.2 Construct formwork and falsework to meet design and regulatory requirements, and to produce finished concrete conforming to surfaces, shapes, lines, and dimensions indicated on Drawings.

.3 Arrange and assemble formwork to permit removal without damage to concrete.

.4 Align joints and make watertight, to prevent leakage of cement paste and disfiguration of concrete. Keep form joints to a minimum. Tape joints as necessary.

.5 Arrange forms to allow removal without removal of principal shores, where these are required to remain in place.

.6 Obtain the Contract Administrator's acceptance before framing openings in concrete slabs, beams, walls, and columns not indicated on Drawings.

.7 Provide falsework to ensure stability of formwork. Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.

.8 Position form joints to suit any expressed lines required in exposed concrete.

.9 Provide chamfer on all external corners and fillets on all internal corners and edges of exposed concrete unless shown otherwise.

.10 Form chases, slots, openings, drips, and recesses if detailed on the Drawings.

.11 Set screeds with top edge level to required elevations.

.12 Check and re-adjust formwork to required lines and levels during placing of concrete.

.13 Where construction joints are required in beams and suspended slabs, form joints at the one third point in the span unless shown or noted otherwise on Drawings.

3.3 Tolerance

.1 Construct formwork to produce concrete with dimensions, lines, and levels shown on the Drawings.

.2 Forms shall be constructed to meet the requirements for shape, dimensions, and tolerances specified in CSA A23.1, Clause 6.4 - Construction Tolerances for Cast-In-Place Concrete.

.3 Tolerances are not cumulative.

.4 Costs for remediation of the formwork shall be borne by the Contractor.

3.4 Inserts/Embedded Items/Openings

.1 Provide formed openings where required for pipes, conduits, sleeves, and other Work to be embedded in and passing through concrete members.

.2 Accurately locate and set in place items that are to be cast directly into concrete. Ensure to secure all items from movement during concrete pour. Puddle in method will not be allowed.

.3 Coordinate Work of other Sections and Divisions and cooperate with trades involved in forming openings, slots, recesses, chases, and setting sleeves, bolts, anchors, and other inserts.

.4 Coordinate installation of concrete accessories as specified in Section 03 15 00 - Concrete Accessories.

.5 Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

.6 Close temporary ports or openings with tight fitting panels, flush with inside face of forms, neatly fitted so no leakage occurs and to provide uniform surface on exposed concrete.

3.5 Field Quality Control

.1 Inspect and check complete formwork, falsework, shoring, and bracing to ensure that Work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and parts are secure.

.2 Ensure the Contractor’s Professional Engineer responsible for the formwork, falsework, and re-shoring design reviews the work prior to each concrete casting. Provide written confirmation from the Contractor’s Professional Engineer that she/he has reviewed the formwork and conforms to the design.

.3 Inform the Contract Administrator when formwork is complete and has been cleaned, to allow for review. The Contract Administrator’s review will be for verification that earth bottoms are clean, and that forms are clean and free from debris.

.4 Allow the Contract Administrator to review each section of formwork prior to re-use. Formwork may be re-used if acceptable to the Contract Administrator. Re-use of forms shall be subject to the requirements of CSA A23.1.

3.6 Cleaning

.1 Clean formwork in accordance with CSA A23.1. Clean forms as erection proceeds to remove foreign matter. Remove cuttings, shavings, and debris from within forms. Flush completely with water to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

.2 During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure. Use compressed air or other means to remove foreign matter.

3.7 Formwork Preparation

.1 Apply form release agent in accordance with Manufacturer's recommendations, prior to placing reinforcing steel, anchoring devices, and embedded parts.

.2 Do not apply form release agent where concrete surfaces are to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces moist prior to placing concrete.

3.8 Form Removal

.1 Notify the Contract Administrator prior to removing formwork.

.2 Do not remove forms and falsework until concrete has gained either sufficient strength to carry its own weight, plus construction loads and design loads that are liable to be imposed or 75% of design compressive strength, whichever is greater. Verify strength of concrete by field cured compression tests to satisfaction of Contract Administrator. Re-shore the concrete structure as directed by the Contract Administrator.

.3 Remove falsework progressively, in accordance with regulatory requirements and ensure that no shock loads or imbalanced loads are imposed on structure.

.4 Loosen forms carefully without damaging concrete surfaces. Do not apply tools to exposed concrete surfaces.

.5 Leave forms loosely in place for protection until curing requirements are complete.

END OF SECTION

CONCRETE ACCESSORIES

1. GENERAL

1.1 Work Included

.1 Expansion Joint Filler.

.2 Joint sealants.

.3 Backer rods.

.4 Non-ferrous grout.

.5 Latex patching agent.

.6 Epoxy bonding agent.

.7 Anchoring adhesive.

.8 Curing and sealing compounds.

.9 Moisture retention film.

.10 Repair mortar.

.11 Epoxy injection system.

.12 Penetrating sealer.

1.2 Qualifications

.1 All sealant installations are to be done by established firm having at least five (5) years of proven, satisfactory experience in these trades and employing skilled personnel.

.2 Epoxy injection installations are to be done by an established firm having at least five (5) years of proven, satisfactory experience in this trade and employing skilled personnel.

.3 Submit proof of qualifications in writing to the Contract Administrator prior to commencement of Work for approval. If firm is deemed to be unqualified, Contractor to employ approved firm at no extra cost.

1.3 Shop Drawings

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

1.4 Maintenance Data

.1 Provide operation and maintenance data for each exposed sealant for incorporation into maintenance manual specified in Section 01 78 00 - Closeout Submittals.

2. PRODUCTS

2.1 Materials

.1 Pre-moulded expansion joint filler (for joints associated with slabs on grade such as pads at doors): asphalt impregnated vegetable or cane fibreboard, conforming to ASTM D1751, sizes indicated on Drawings. Acceptable products: W. R. Meadows Sealtight Fibre Expansion Joint Filler complete with Snap-Cap and Sealtight #164, Hi-Spec, Cold Applied SOF-Seal sealant, Fosroc Fibreboard complete with Pliastic or Colpor 200PF sealant, or approved equal in accordance with B7.

.2 Sealants:

.1 Joint sealants for non-liquid-retaining areas - interior saw cut joint: Dow Corning No. 795 or approved equal in accordance with B7. Provide custom colour(s) for control joint sealant and colour is to match paint for concrete block. Provide Limestone colour for saw cut joints.

.2 Joint sealants for non-liquid-retaining areas - exterior saw cut joints: Dow Corning No. 795. Provide Limestone colour for saw cut joints or approved equal in accordance with B7.

.3 Primers: as recommended and supplied by sealant Manufacturer.

.4 Backer rod: closed cell vinyl foam.

.5 Non-ferrous grout: pre-mixed, non-shrink, Master Builders 713, Sika Canada Sika M-Bed, CPD Non Shrink Grout, Steel C1 Grout or approved equal in accordance with B7, minimum 35 MPa compressive strength.

.6 Anchoring adhesive at and above the Main Floor elevation: Hilti HIT HY-200 Adhesive or approved equal in accordance with B7. Utilize Hilti HIT-ICE or approved equal in accordance with B7 for cold weather applications.

.7 Moisture retention film: Master Builders Confilm, Sika Canada Sika Film, TK Products Tri Film or approved equal in accordance with B7.

.8 Repair mortar:

.1 Horizontal area not exposed to view: Sika Canada SikaTop 122 Plus or approved equal in accordance with B7.

.2 Vertical area not exposed to view: Sika Canada SikaTop 123 Plus or approved equal in accordance with B7.

.3 Exposed to view: W. R. Meadows Meadow-Crete H or approved equal in accordance with B7.

.9 Epoxy injection system: Specton Flex F1000 or approved equal in accordance with B7. Water Activated Polyurethane Urethane Grout.

3. EXECUTION

3.1 Examination

.1 Before starting this Work, examine all Work done by other Division within Contract.

.2 Notify the Contract Administrator of any conditions that would prejudice proper completion of this Work.

.3 Commencement of Work implies acceptance of existing conditions.

.4 The Contract Administrator, at his discretion may complete isolated destructive testing of the in-place sealants. Contractor is to remediate areas where destructive testing occurs at the Contractor's expense.

3.2 Installation

.1 Pre-installation Conference for epoxy injection, and sealant: one (1) week prior to installation of the above products into the Works, the Contractor shall conduct a meeting with applicator, installers of Work adjacent to or that penetrates the sealant products, and the Contract Administrator to review the following:

.1 General project requirements.

.2 Manufacture's product data sheets and installation guides.

.3 Substrate conditions and procedures for substrate preparation and product installations.

.4 Responsibility and costs associated with verification and correlation of field dimensions, fabrication processes, techniques of construction, installation, and coordination for all parts of the Work rests with the Contractor. 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.

.5 Pay for all costs associated with the pre-installation conference excluding the Contract Administrator cost.

.2 Install all concrete accessories in accordance with Drawings and Manufacturer's recommendations and ensure compatibility. Install straight, level, and plumb.

.3 Ensure items are not disturbed during concrete placement.

.4 Coordinate Work of this Section with other construction.

3.3 Repair Mortar

.1 Apply repair mortar for defective concrete where directed by the Contract Administrator.

.2 Prepare surfaces and apply repair mortar to Manufacturer's instructions. Use pea gravel to extend the mixture in accordance with the Manufacturer's instructions.

3.4 Epoxy Injection

.1 Allow Contract Administrator to review dry temperature and shrinkage cracks prior to injection.

.2 Clean the cracks using the Manufacturer's approved cleaning agent and procedures prior to injection of resin.

.3 Injection to be completed in accordance with the Manufacturer's written instructions.

.4 Remove any cured injection resin from the surface of the structure.

.5 Allow minimum twenty-four (24) hours for the injection resin to cure prior to removal and patching of the packer holes.

END OF SECTION

CONCRETE REINFORCING

1. GENERAL

1.1 Work Included

.1 Reinforcing steel bars for cast-in-place concrete, complete with tie wire.

.2 Support chairs, bolsters, bar supports, spacers, and tie wire for reinforcing.

1.2 Quality Assurance

.1 Perform concrete reinforcing work in accordance with CSA A23.1.

1.3 Inspection and Testing

.1 Submit three (3) certified copies of the mill test report of reinforcement supplied, indicating physical and chemical analysis.

1.4 Shop Drawings

.1 Submit bar lists and placing drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Clearly indicate bar sizes, spacing, locations and quantities of reinforcing steel and wire fabric, bending and cutting schedules and supporting and spacing devices.

.3 Drawings and details to conform to CSA A23.1, CSA-A23.3, and RSIC's Reinforcing Steel Manual of Standard Practice.

.4 Detail placement of reinforcing where special conditions occur.

.5 Detail splice lengths, bar development and hook development as shown on the Structural General Notes Drawing except as noted on other Drawings that indicated longer; splice length, bar development and hook developments. Use Class B top tension lap splices unless noted otherwise.

.1 All other details are to be maintained in accordance with CSA A23.1 and RSIC's Reinforcing Steel Manual of Standard Practice.

1.5 Delivery and Storage

.1 Deliver, handle, and store reinforcement in a manner to prevent damage and contamination.

.2 Deliver bars in bundles, clearly identified in relation to bar lists.

.3 Tarp/store bars to keep out of rain and snow. Store bars off of the ground.

2. PRODUCTS

2.1 Reinforcing Materials

.1 Reinforcing steel: 400 MPa yield grade; deformed billet steel bars conforming to CSA G30.18; plain finish.

2.2 Accessory Materials

.1 Tie wire: minimum 1.6 mm annealed type or patented system accepted by the Contract Administrator.

.2 Chairs, bolsters, bar supports, and spacers: adequately sized for strength and support of reinforcing steel during construction in accordance with the RSIC's Reinforcing Steel Manual of Standard Practice.

.3 Bar chairs to be non-corrosive PVC chairs or purpose made concrete chairs.

.4 Side form spacers to be non-corrosive PVC spacers, purpose made.

.5 Steel bar chairs, galvanized bar chairs, PVC chairs, concrete bricks, broken concrete blocks, or wood supports are not acceptable.

3. EXECUTION

3.1 Examination

.1 Before starting this Work, examine work done by other Division within Contract.

.2 Notify the Contract Administrator of any conditions that would prejudice proper completion of this Work.

.3 Commencement of Work implies acceptance of existing conditions.

3.2 Fabrication

.1 Fabricate reinforcing steel in accordance with CSA A23.1 and the Drawings.

.2 Locate reinforcing splices not indicated on the Drawings at points of minimum stress.

.3 Fabricate within the following tolerances:

.1 Sheared length: plus 0, minus 25 mm.

.2 Stirrups, ties, and spirals: plus 0, minus 10 mm.

.3 Depth of truss bars: plus 0, minus 10 mm.

.4 All bending shall be done cold with a suitable machine accurately producing all lengths, depths, and radii shown on the bending details.

.5 After initial fabrication, reinforcing steel shall not be re-bent or straightened unless so indicated on the Drawings.

.6 Heating of reinforcing steel will not be permitted.

3.3 Installation

.1 Place reinforcing steel in accordance with reviewed placing drawings and CSA A23.1.

.2 Chairs supporting slab reinforcing shall not be further apart than 1200 mm in either direction. Tie reinforcing steel at maximum spacing 600 mm.

.3 Adequately support reinforcing and secure against displacement within tolerances permitted.

.4 Place reinforcing steel to provide concrete cover as required by CSA A23.1, but not less than shown in the following table, unless shown otherwise on the Drawings:

Location	**Coverage (mm)**
Top and sides of beams	40
Top, sides and bottom of interior floor slab	25
Top, sides and bottom of exterior slab	50
Surface poured against ground, piles, bottom of slabs on grade	75
Pile caps (all faces and to outside of ties/stirrups)	60
Housekeeping pads	50

.5 Place reinforcing bars to tolerances in accordance with CSA A23.1, Clause 6.6 – Fabrication and Placement of Reinforcement. Tolerances are not cumulative.

3.4 Safety Protection for Reinforcing Ends

.1 Highly visible protection safety caps or other acceptable safety product shall be installed for all reinforcing ends immediately following placement of bars.

.2 The reinforcing end protection shall be made secure so that accidental contact will not easily dislodge the protection. Dislodged protection shall be re-installed immediately.

3.5 Cleaning

.1 Ensure concrete reinforcing is clean and free from oil and deleterious matter.

.2 Remove all loose scale, loose rust, concrete from prior pours, and other deleterious matter from surfaces of reinforcing.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Supply of all reinforced cast-in-place concrete shown on the Drawings.

.2 Setting anchors, inserts, frames, sleeves, and other items supplied by other Sections.

.3 Placing and curing of concrete.

.4 Finishing formed concrete surfaces.

.5 Finishing concrete slab surfaces.

.6 Repairing concrete imperfections.

.7 Third-party Testing.

1.2 References

.1 National Building Code of Canada and Manitoba Amendments.

.2 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.3 CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.4 ASTM C 260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.

.5 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.

.6 All standards to be latest edition unless noted otherwise.

1.3 Quality Control

.1 The Contractor shall be fully responsible for quality control of all aspects of production, pre-placement, placement, and post-placement of concrete and related testing.

.2 Cast-in-place concrete shall conform to the CSA A23.1. Concrete shall be delivered under the Performance Alternative as outlined in CSA A23.1, Table 5.

.3 Testing of cast-in-place concrete shall be performed by a CSA A23.1 certified Third-party Testing Agency paid for by the Contractor. Testing shall conform to CSA A23.1/A23.2, and as specified below.

.1 Take three (3) test cylinders from each 50 cubic metres of each class of concrete placed or for each day of concrete placement if the latter is less than 50 cubic metres. Testing shall be as follows:

.1 One (1) – Seven (7) day laboratory cured test.

.2 Two (2) – Twenty-eight (28) day laboratory cured tests.

.2 Take one (1) additional test cylinder during cold weather concreting or if Sulphate resistance cement has been used. Cure cylinder on job site under same conditions as concrete that it represents.

.3 Make at least one (1) slump test for each set of test cylinders taken.

.4 Cure concrete test cylinders in location designated by testing agency for a minimum of forty-eight (48) hours prior to transporting to laboratory.

.5 Additional testing required due to low, inaccurate or otherwise questionable results shall be paid by the Contractor.

.6 Distribute the Third-party Testing Agency test data to the Contract Administrator and City immediately upon receiving.

.7 Submit and implement a Quality Control Plan a minimum of four (4) weeks prior to first scheduled concrete casting; the Quality Control Plan shall include:

.1 Identify the Quality Control Manager.

.2 Qualifications of construction supervisory personnel.

.3 Quality Control testing plan for concrete.

.4 Third-party testing data from trial batching of each mix type.

.5 Pre-placement procedures, checklists, and project specific finishing procedures for concrete.

.6 During placement contingency plans and procedures.

.7 Post-placement procedures and checklists for concrete.

.8 Submit mix design statements for each type of concrete:

.1 Mix design statements shall be sealed and signed by a Professional Engineer registered in the Province of Manitoba experienced 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 Table 1 at the end of this Section.

.9 Submit the Quality Control Plan and mix design statements in accordance with Section 01 33 00 - Submittal Procedures.

1.4 Quality Assurance

.1 Checklists supplied by the Contractor and approved for use by the Contract Administrator will be used for reviewing the Work.

.2 Notify the Contract Administrator at least forty-eight (48) hours before complete formwork, embedded items, and concrete reinforcement is ready for review. Contractor shall schedule review of embedded items and reinforcing in walls prior to closing forms.

.3 Allow ample time for review, and corrective work, if required, before scheduling concrete placement.

.4 The City reserves the right to arrange and pay for a CSA A23.1 certified Third-party Testing Agency to test the concrete works. Provide unencumbered access to all portions of the Work and cooperate with appointed Third-party Testing Agency.

2. PRODUCTS

2.1 General

.1 All materials in concrete mixes shall be compatible.

2.2 Concrete Materials

.1 Portland Cement: Type GU/GUb and Type HS or HSB to CSA A3000.

.2 Fine aggregate: conforming to Normal-Density Fine Aggregate, CSA A23.1, Tables 10 and 12. Provide evidence at least four (4) weeks before use in concrete mix showing conformance to Normal-Density Fine Aggregate, CSA A 23.1.

.3 Coarse aggregate: conforming to Normal-Density Coarse Aggregate, CSA A23.1, Table 11 and 12. Provide evidence at least four (4) weeks before use in concrete mix showing conformance to Normal-Density Coarse Aggregate, CSA A 23.1.

.4 Ensure that no aggregates are used that may undergo volume change due to alkali reactivity, moisture retention or other causes. Confirm suitability of aggregate with a petrographic analysis.

.5 Water: potable, clean, and free from injurious amounts of oil, alkali, organic matter, or other deleterious matter, meeting requirements of CSA A23.1, Table 9.

.6 Materials are to be obtained from the same source of supply or Manufacturer for the duration of the Project.

.7 Supplementary cementing materials: conforming to CSA A3000.

2.3 Admixtures

.1 Air entrainment: conforming to ASTM C 260/C260M.

.2 Chemical admixtures, water-reducing agent, superplasticizer: conforming to ASTM C 494.

.3 Admixtures containing chlorides will not be permitted.

2.4 Accessories

.1 For accessories refer to Section 03 15 00 - Concrete Accessories.

2.5 Concrete Mixes

.1 Provide concrete mixed in accordance with requirements of CSA A23.1 and this Specification Section. Pay all costs for the mix design.

.2 Concrete design compressive strength and class of exposure as indicated in attached Table 1. Concrete mixes are to be designed to mitigate dry and plastic temperature and shrinkage cracks.

.3 Conduct trial batching for each mix type in Table 1. Conduct testing of each trail batch to ensure the mix deign meets the requirements 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.

.4 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.

.5 Use set-retarding admixtures during hot weather only when accepted by the Contract Administrator.

.6 All admixtures are subject to acceptance by the Contract Administrator. List all proposed admixtures in mix design statement submission. Do not change or add admixtures to accepted design mixes without the Contract Administrator's review and acceptance.

.7 Concrete delivered to site must be accompanied by a delivery slip in accordance with CSA A23.1.

.8 Self-consolidating concrete mixes will not be permitted for use on this project.

3. EXECUTION

3.1 Pre-Installation Conference

.1 Pre-installation conference for cast-in-place concrete: four (4) weeks prior to installation of concrete works, the Contractor shall conduct a meeting with mix designer, batch plant quality control manager, third-party testing agency representative, concrete installers, concrete finishers, concrete curing applicators, concrete sealer technical representative, reinforcing steel installers, floor coating applicators, installers of work adjacent to or that penetrates the concrete works, and the Contract Administrator to review the following:

.1 General project requirements;

.2 Concrete sequence plan showing construction joints;

.3 Contractor's quality control plan for each class of concrete; and

.4 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 Placing Concrete

.1 Place concrete in accordance with requirements of CSA A23.1 and as indicated on the Drawings. Layout of the Work and accuracy of same is the Contractor's sole responsibility.

.2 Place concrete to mitigate dry and plastic temperature and shrinkage cracks.

.3 Prior to the erection of the formwork, construction joints shall be sand blasted and cleaned as per clause 3.8 - Construction Joints of this Specification Section.

.4 Notify the Contract Administrator a minimum of forty-eight (48) hours prior to placing concrete. Under no circumstances shall concrete be placed without notifying Contract Administrator.

.5 Arrange for testing of cast-in-place concrete.

.6 The concrete shall be placed rapidly and evenly as near to its final position as possible to reduce the risk of segregation, flowlines, and cold joints.

.7 Ensure all anchor bolts, seats, plates, and other items to be cast into concrete are securely placed and will not interfere with concrete placement and will not be displaced during casting.

.8 All equipment for transporting the concrete shall be cleaned of hardened concrete and foreign materials before placing concrete.

.9 Immediately before concrete is placed, Contractor shall carefully inspect all forms in accordance with Section 03 10 00 - Concrete Forming and Accessories, to ensure that they are properly placed, sufficiently rigid and tight, and that all reinforcing steel and embedded parts are in the correct position and secured against movement during the placing operation. All forms shall be thoroughly cleaned and material removed.

.10 Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods that will prevent the separation or loss of the ingredients. Concrete shall be deposited in the forms as nearly as practicable in its final position to avoid re-handling or flowing. Vibrators shall not be used to move concrete. Under no circumstances shall concrete that has partially hardened be deposited in the forms.

.11 Concrete shall be thoroughly compacted by mechanical vibrators during placing operations. Concrete shall be thoroughly worked around the reinforcement, embedded fixtures and into the corners of the forms.

.12 Vibrate concrete using the appropriate size equipment as placing proceeds, in accordance with CSA A23.1. Check frequency and amplitude of vibrations prior to use. Provide additional standby vibrators in the event of equipment failure.

.13 Where placing operations would involve dropping the concrete more than 1500 mm, it shall be placed through canvas hoses or galvanized iron chutes. Concrete shall not be raised at a rate greater than that for which proper vibration may be affected.

.14 In locations where new concrete is dowelled to existing concrete, drill holes in existing concrete, clean thoroughly, pack solidly with epoxy grout suitable for intended exposure, and insert steel dowels.

.15 At construction or expansion joints a minimum of three (3) days shall elapse between adjacent castings and the adjacent casting shall have obtained 75% of the design strength.

.16 Do not place concrete if carbon dioxide producing equipment has been in operation in the building or in the enclosure during the twelve (12) hours preceding the pour. This equipment shall not be used during placing or for twenty-four (24) hours after placing. During placing and curing concrete, surfaces shall be protected by formwork or an impermeable membrane from direct exposure to carbon dioxide, combustion gases or drying from heaters.

.17 Honeycomb and embedded debris are not acceptable.

.18 Remove and replace defective concrete.

.19 Maintain accurate records of cast-in-place concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

.20 Prepare set or existing concrete by removing all laitance and loose or unsound materials and apply bonding agent in accordance with manufacturer's recommendations.

3.3 Hot and Cold Weather Concreting

.1 Deliver, place and cure concrete in hot or cold weather in accordance with the requirements in CSA A23.1.

3.4 Concrete Protection for Reinforcement

.1 Ensure reinforcement is placed to provide minimum concrete cover in accordance with Section 03 20 00 - Concrete Reinforcement.

3.5 Construction Tolerance

.1 The Work shall be carefully and accurately set out; true to the positioning, levels, slopes, and dimensions shown on the Drawings and conforming to tolerance requirements of CSA A23.1 and Section 03 10 00 - Concrete Forming and Accessories and Section 03 20 00 - Concrete Reinforcing.

.2 If these tolerances are exceeded, the Contractor shall, at the discretion of the Contract Administrator, be required to remove and replace, or to modify the placed concrete before acceptance at own cost.

3.6 Finishing Slab Surfaces

.1 Screeding, bull floating or darbying, floating, and trowelling of slab surfaces shall conform to CSA A23.1.

.1 Finish interior main floor slab surfaces to CSA A23.1, Table 21, Class A utilizing magnesium bull float followed by magnesium hand float for air entrained concrete and steel blade power trowel for non-air entrained concrete.

.2 Finish exterior equipment slab surfaces to CSA A23.1, Table 21, Class A utilizing magnesium bull float followed by magnesium hand float for air entrained concrete and steel blade power trowel for non-air entrained concrete.

.2 Broom finish exterior slab surfaces to achieve nonslip surface conforming to CSA A23.1.

3.7 Finishing Formed Concrete

.1 Allow the Contract Administrator to review concrete surfaces immediately upon removal of the forms.

.2 Modify or replace concrete not conforming to qualities, lines, details, and elevations specified herein or indicated on the Drawings to the satisfaction of the Contract Administrator.

.3 Finish for the exterior surfaces of the substructure shall be rough-form finish conforming to CSA A23.1, Clause 7.7.

3.8 Construction Joints

.1 Construction joint locations shall be as shown on the Drawings.

.2 Joints not indicated on the Drawings shall be located so as to least impair the strength of the structure. The location of these joints shall be subject to prior review and acceptance by the Contract Administrator. Submit location and detail of joints to Contract Administrator a minimum of four (4) weeks prior to scheduled concrete casting. Joints shall be in accordance with CSA A23.1, or as indicated on the Drawings.

.3 The surface of hardened concrete shall be thoroughly cleaned of foreign matter and laitance by sand blasting, and shall be thoroughly wetted with water, but not saturated, and the forms shall be re-tightened against the face of the hardened concrete before depositing additional concrete. Any concrete splatter on reinforcing bars shall be removed by sand blasting or other mechanical means.

.4 For horizontal construction joints, the concrete shall be thoroughly compacted by hand trowel in and around the reinforcing bars.

3.9 Curing and Protection

.1 Cure and protect freshly placed concrete in accordance with CSA A23.1.

.2 Floor slabs shall receive extended wet curing for a period of at least seven (7) calendar days.

.1 Surface covered with canvas or other satisfactory material and kept thoroughly and continuously wet with soaker hoses.

.3 All other concrete shall receive moist curing for a period of at least seven (7) calendar days. One of the following methods shall be used as soon as the concrete has hardened sufficiently to prevent marring:

.1 Surface covered with canvas or other satisfactory material and kept thoroughly and continuously wet with soaker hoses.

.2 A liquid membrane forming curing sealer, applied at the rate recommended by the manufacturer. Curing sealer shall not be used on a surface where bond is required for the finishes.

.3 Surfaces of concrete that are protected by formwork that is left in place for seven (7) calendar days, shall not require any additional curing (except as specified for hot weather). If the formwork is removed in less than seven (7) calendar days, the concrete shall receive moist curing as above.

.4 No concreting will be allowed until all materials required for the curing phase are on-site and ready for use.

.5 At the end of the curing and protection period, the temperature of the concrete shall be reduced gradually at a rate meeting both the requirements of CSA A23.1 Table 21 for allowable differential temperature in the concrete and ACI 306R Table 5.1 for the allowable rate of temperature change of the edges of the concrete until the outside air temperature has been reached.

.6 Concrete that is allowed to freeze, the Contract Administrator suspects has frozen, or obtained insufficient curing conditions shall be subject to all necessary investigations and testing as deemed necessary by the Contract Administrator and all such concrete shall be removed and the portion reconstructed as directed by the Contract Administrator, at the Contractor's cost.

.7 Use water available on Site for curing concrete.

3.10 Equipment Pads, Pipe Supports, and Cast in Metal Items

.1 Provide concrete pads and supports for equipment where and as indicated on Drawings. Adjust dimensions to reviewed equipment Shop Drawings.

.2 Insert bolts and sleeves and pack solidly with non-shrink grout, in accordance with setting details and templates.

.3 Steel trowel surface smooth. Chamfer exposed horizontal and vertical edges.

.4 Clean excess concrete from metal frames, inserts, weld plates, etc. Clean and tool concrete around the above noted items.

3.11 Grouting

.1 Grout all miscellaneous anchor bolts with non-ferrous or epoxy grout as specified or as required per reviewed equipment Shop Drawings using templates for accurate positioning.

.2 Prepare adjoining surfaces in accordance with the grout manufacturer's written instructions.

.3 Install and cure the grout in accordance with the grout manufacturer's written instructions.

3.12 Defective Concrete

.1 Concrete not meeting the requirements of the Specifications and Drawings will be considered defective concrete.

.2 Concrete not conforming to the lines, details, and grades specified herein or as shown on the Drawings shall be modified or replaced at the Contractor's expense and to the satisfaction of the Contract Administrator. Finished lines, dimensions, and surfaces shall be correct and true within tolerances specified herein and in Section 03 10 00 - Concrete Forming and Accessories.

.3 Concrete not properly placed resulting in honeycombing and other defects shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Contract Administrator.

3.13 Repair

.1 Allow Contract Administrator to review concrete surfaces immediately upon removal of all formworks.

.2 Remove all exposed metal form ties, nails, and wires, break off fins and remove all loose concrete.

.3 Any imperfect joints, voids, stone pockets, or other defective areas and tie holes, as specified, shall at once be patched before the concrete is thoroughly dry. Defective areas shall be chipped away to a depth of not less than 40 mm with sawcut edges perpendicular or dovetail to the surface. The area to be repaired and a space at least 150 mm wide entirely surrounding it shall be wetted to prevent absorption of water from the repair mortar.

.4 Cure all repairs thoroughly in accordance with Manufacturer's instructions.

Table 1: Concrete Mix Types

Mix Type	Intended Application	Minimum Compressive Strength (MPa)	Class of Exposure
1	Exterior Below Ground Works: • Piles, pile caps, walls, grade beams.	35 at 56 Days	S-1
2	Structural and Non-Structural Concrete for Exterior Works: • Exterior slab on grade, structural slab, bollard infill.	32 at 28 Days	C-2
3	Structural or Non-Structural Interior Works: • Slab, columns, beams, curb, housekeeping pad.	35 at 28 Days	N
4	Concrete grout for masonry infill.	20 at 28 Days	N
5	Concrete topping.	25 at 28 Days	N

END OF SECTION

COMMON WORK RESULTS FOR MASONRY

1. GENERAL

1.1 Work Included

.1 Masonry Work is described in other Sections of Division 4.

1.2 References

.1 CSA A179, Mortar and Grout for Unit Masonry.

.2 CSA A371, Masonry Construction for Buildings.

1.3 Samples

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

.2 Submit samples:

.1 Two (2) of each type of masonry unit specified.

.2 Two (2) of each type of masonry veneer unit specified.

.3 One (1) of each type of masonry accessory specified.

.4 One (1) of each type of masonry reinforcement and tie proposed for use.

.5 As required for testing purposes.

1.4 Information Submission

.1 Shop Drawings:

.1 Provide drawings stamped and signed by Professional Engineer registered or licensed in Province of Manitoba, Canada.

.2 Provide Shop Drawings detailing temporary bracing required, designed to resist wind pressure and lateral forces during installation.

.3 Provide Shop Drawing showing the location of the control joints, details of the control joints as per CSA A371.

.2 Certificates: provide manufacturer's product certificates certifying materials comply with specified requirements.

.3 Test and Evaluation Reports:

.1 Provide certified test reports.

.2 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.

.4 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, and cleaning.

1.5 Product Delivery, Storage and Handling

.1 Deliver materials to job Site in dry condition.

.2 Keep materials dry until use, except where wetting of bricks is specified.

.3 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

1.6 Cold Weather Requirements

.1 Supplement Clause 6.7.2.3 of CSA A371 with the following requirements:

.1 Maintain temperature of mortar between 5°C and 50°C until batch is used.

.2 Hoard equipment and materials to maintain temperature between 5°C and 50°C.

1.7 Hot Weather Requirements

.1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

1.8 Protection

.1 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.

.2 Protect masonry and other Work from marking and other damage. Protect completed Work from mortar droppings. Use non-staining coverings.

.3 Provide temporary bracing of masonry Work during and after erection until permanent lateral support is in place.

2. PRODUCTS

2.1 Materials

.1 Masonry materials are specified in other Sections of Division 4.

3. EXECUTION

3.1 Workmanship

.1 Do masonry Work in accordance with CSA A371 except where specified otherwise.

.2 Build masonry plumb, level, and true to line, with vertical joints in alignment.

.3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.2 Tolerances

.1 Tolerances to CSA A371.

3.3 Exposed Masonry

.1 Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.

3.4 Jointing

.1 Allow joints to set just enough to remove excess water, and then tool with round joints to provide smooth, compressed, uniformly concave joints where concave joints are indicated.

.2 Strike flush all joints concealed in walls and joints in walls to receive insulation, or other applied material except paint or similar thin finish coating.

3.5 Cutting

.1 Cut out neatly for electrical switches, outlet boxes, and other recessed or built-in objects.

.2 Make cuts straight, clean, and free from uneven edges.

3.6 Building-in

.1 Build in items required to be built into masonry.

.2 Prevent displacement of built-in items during construction. Check plumb, location, and alignment frequently, as Work progresses.

.3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.

3.7 Support of Loads

.1 Use concrete to Section 03 30 00 - Cast-in-Place Concrete, where concrete fill is used in lieu of solid units, such as vertical cores, bond beams, and lintels.

.2 Install building paper below voids to be filled with concrete or grout; keep paper 25 mm back from faces of units.

3.8 Provision for Movement

.1 Co-ordinate the roof deflection space required between a masonry wall and a roof component.

3.9 Control Joints

.1 Construct continuous control joints as per CSA A371. Construct continuous control joints to be a maximum 8 m o/c.

.2 Provide Shop Drawing showing the location of the control joints and details of the control joints.

3.10 Field Quality Control

.1 Inspection and testing will be carried out by a testing laboratory designated by the Contractor and as approved by the Contract Administrator.

.2 The Contractor will pay costs for testing as incidental to the Contract.

END OF SECTION

MASONRY MORTARING

1. GENERAL

1.1 Work Included

.1 Provide all materials and labour to perform the mortar and grout Work for all masonry walls indicated on the Drawings.

1.2 References

.1 CSA A179 Mortar and Grout for Unit Masonry.

1.3 Samples

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

2. PRODUCTS

2.1 Materials

.1 Mortar and grout: conforming to CSA-A179.

.2 Aggregate: conforming to CSA-A179.

.3 Water: clean, potable, free of injurious amounts of acids, alkalis, and organic material.

.4 Masonry cement: conforming to CSA-A3002, Type S.

.5 Portland cement: conforming to CSA-A3001, normal Type GU.

.6 Hydrated lime: conforming to ASTM C207.

.7 Dirt resistant additives: aluminum tristearate, calcium stearate, or ammonium stearate.

2.2 Material Source

.1 Use same brands of materials and source of aggregate for entire Project.

2.3 Mortar Types

.1 Mortar for all masonry:

.1 Type S based on Property Specifications.

2.4 Grout

.1 Grout: to CSA-A179, Table 3.

3. EXECUTION

3.1 Mixing

.1 Do masonry mortar and grout Work in accordance with CSA A179 except where specified otherwise.

.2 Mix grout to semi-fluid consistency.

.3 Incorporate admixtures into mixes in accordance with Manufacturer's instructions.

.4 Comply with cold weather requirements specified in CSA A371 Masonry Construction for Buildings.

3.2 Testing

.1 The City reserves the right to arrange and pay for a certified Third Party Testing Agency to perform additional testing. Provide unencumbered access to all portions of the Work and cooperate with appointed Third Party Testing Agency.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Supply all material and labour for the incorporation of the masonry reinforcement and connectors into the Work of this Contract.

1.2 References

.1 CSA A23.1, Concrete Materials and Methods of Concrete Construction.

.2 CSA A370, Connectors for Masonry.

.3 CSA A371, Masonry Construction for Buildings.

.4 CSA G30.3, Cold-Drawn Steel Wire for Concrete Reinforcement.

.5 CSA G30.18, Billet-Steel Bars for Concrete Reinforcement.

.6 CSA S304.1, Masonry Design for Buildings (Limit States Design).

.7 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.3 Source Quality Control

.1 Submit certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, minimum five (5) weeks prior to commencing reinforcement Work.

.2 Inform the Contract Administrator of proposed source of material to be supplied.

1.4 Shop Drawings

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

.2 Shop Drawings shall consist of bar bending details, lists, and placing drawings.

.3 On placing Shop Drawings, indicate sizes, spacing, location, and quantities of reinforcement and connectors.

2. PRODUCTS

2.1 Materials

.1 Bar reinforcement: to CSA A371 and CSA-G30.18, Grade 400.

.2 Wire reinforcement: to CSA A371 and CSA-G30.3, Truss type.

.3 Corrosion protection: to CSA S304.1, galvanized.

.4 Masonry anchors: acceptable products by Hilti or approved equal in accordance with B7.

.5 Connectors: to CSA A370 and CSA S304.1.

.1 Slotted block tie complete with insulation clip to masonry support wall.

.2 Slotted extension strip for dimensional stone veneer.

.6 Corrosion protection: to CSA S304.1, galvanized to CSA-S304.1 and CSA A370.

.7 Ties: hot dip galvanized to CSA A370 Table 5.2 steel finish.

.1 Corrugated to CSA A370.

.2 Unit ties, to CSA A370: Z style, fabricated from galvanized cold-drawn steel, size to suit application.

.3 Adjustable Unit Ties: to CSA A370: proprietary type ties, type, style and size to suit application in accordance with Manufacturer's recommendations.

.1 Minimum spacing:

.1 Vertical: 600 mm.

.2 Horizontal: 800 mm.

.2 From opening edge/corner: 200 mm max.

.4 Joint Reinforcement Ties: to CSA A370:

.1 Single Wythe Joint Reinforcement: Truss type:

.1 Steel wire, hot dip galvanized: to ASTM A 641M, Class 1 after fabrication.

.2 Cold drawn steel wire conforming to ASTM A 82/82M.

.8 Control joint filler: preformed rubber, neoprene, or polyvinyl chloride materials of size and shape indicated.

.9 Movement Joint Filler: purpose-made, of size and shape indicated.

.1 Maximum VOC content - 250 g/L (less water) in accordance with SCAQMD Rule 1168.

.2 Material type: self-expanding, pre-compressed, open cell, 100% acrylic, impregnated expanding foam sealant, with self-adhesive on one face.

.10 Lap adhesive: recommended by masonry flashing manufacturer.

.1 Maximum VOC Content: 80 g/L (less water) in accordance with SCAQMD Rule 1168.

.11 Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, honeycomb design, full height and width of head joint and depth 3 mm less than depth of outer wythe, in colour selected from manufacturer's standard range.

.1 Blok-Lok Cellvent, Advanced Building Products Mortar Maze Cell Vents, or approved equal in accordance with B7.

.12 Mortar Dropping Control Device: Free-draining mesh; made from polymer strands that will not degrade within wall cavity.

.1 Strips, full-depth of cavity and 250 mm high, with dovetail shaped notches 175 mm deep that prevent clogging with mortar droppings.

.2 Acceptable products: Mortar Net “Mortar Net”, Hohmann & Barnard, Inc. “Mortar Trap”, or approved equal in accordance with B7.

.13 Grout Screens: 6 mm square monofilament screen is fabricated form high-strength, non-corrosive polypropylene polymers to isolate flow of grout in designated areas.

.1 Size: width to suit masonry units by 30 m.

.14 Flashings:

.1 Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual". Fabricate metal drip edge from galvanized sheet steel, 0.61 mm thick, in sections 2400 mm long minimum. Extend at least 75 mm into wall and 13 mm out from wall, with outer edge bent down 30 degrees and hemmed.

.2 Flexible Through Wall Flashing: self-adhering, as specified for air/vapour barrier specified in Section 07 21 20 - Rigid Insulation and Air Barrier.

2.2 Fabrication

.1 Fabricate reinforcing in accordance with CSA A23.1.

.2 Fabricate connectors in accordance with CSA A370.

.3 Obtain the Contract Administrator's acceptance for locations of reinforcement splices other than shown on placing drawings.

.4 Subject to review by the Contract Administrator, weld reinforcement in accordance with CSA W186.

.5 Ship reinforcement and connectors, clearly identified in accordance with the Drawings.

3. EXECUTION

3.1 General

.1 Install masonry connectors and reinforcement in accordance with CSA A370, CSA A371, CSA A23.1 and CSA S304.1 unless indicated otherwise.

.2 Comply with Manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.3 Prior to placing concrete and mortar, obtain Contract Administrator's acceptance of placement of reinforcement and connectors.

.4 Do additional reinforcement of masonry as indicated.

3.2 Flashing, Weep Holes, Cavity Drainage, and Vents

.1 General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

.2 Vents: Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products or open head joints to form vents.

.1 Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

.3 Mortar Dropping Control Devices: Install mortar dropping control devices in cavity air space continuously at base of wall, shelf angles, and lintels over openings.

.4 Grout Screens: Install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.

.5 Build in flashings in masonry in accordance with CSA A371.

.1 Prepare concrete and masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

.2 At lintels, extend flashing minimum 150 mm into masonry at each end. At heads and sills, extend flashing 150 mm at ends and turn up not less than 50 mm to form end dams.

.3 Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 13 mm back from outside face of wall and adhere flexible flashing to top of metal drip edge.

.4 In cavity walls and veneered walls, carry flexible flashings from front edge of exterior masonry, under outer wythe, then up backing not less than 200 mm. Bond to wall using manufacturer's recommended adhesive.

.5 Lap joints 150 mm and seal with adhesive.

.6 Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

.7 Install vertical flashing where outer veneer returns at window or door jambs, to prevent contact of veneer with inner wall.

3.3 Bonding and Tying

.1 Tie masonry veneer to backing in accordance with NBC, CSA S304.1, CSA A371, and as indicated.

3.4 Reinforced Lintels and Bond Beams

.1 Reinforce masonry lintels and bond beams as indicated.

.2 Place and grout reinforcement in accordance with CSA S304.1.

3.5 Grouting

.1 Grout masonry in accordance with CSA S304 and as indicated.

3.6 Masonry Anchors

.1 Install metal anchors where indicated.

.2 If masonry anchors are not specified on the Drawings, review proposed anchor and application with the Contract Administrator prior to use.

3.7 Lateral Support and Anchorage

.1 Do lateral support and anchorage in accordance with CSA S304.1 and as indicated.

3.8 Control Joints

.1 Terminate reinforcement 25 mm short of each side of control joints unless otherwise indicated.

3.9 Field Bending

.1 Do not field bend reinforcement and connectors except where indicated or authorized by Contract Administrator.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars and connectors which develop cracks or splits.

3.10 Cleaning

.1 Upon completion of installation, remove surplus materials, rubbish, tools, and equipment barriers.

END OF SECTION

BRICK MASONRY

1. GENERAL

1.1 Work Included

.1 Brick veneer.

.2 Installation of Brick Veneer Accessories.

1.2 Standards

.1 ASTM International:

.1 ASTM C73-10, Standard Specification for Calcium Silicate Brick (Sand-Lime Brick).

.2 ASTM C216-13, Standard Specification for, Facing Brick (Solid Masonry Units Made of Clay or Shale).

.2 Brick Industry Association (BIA):

.1 Technical Note No. 20- 2006, Cleaning Brick Work.

.3 Perform masonry Work to CSA A82, CSA S304.1, CSA A370, and CSA A371 except where specified otherwise.

.4 Conform to National Building Code of Canada 2010 and the Manitoba Amendments.

1.3 Shop Drawings

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

.2 Clearly indicate sizes, connections, attachments, reinforcing, anchorage, size, and type of fasteners and accessories.

.3 Include erection drawings, elevations, and details where applicable.

1.4 Quality Assurance

.1 Conform to weather protection requirements in CSA A82.

.2 Masonry units shall be warmed to minimum 5°C prior to install.

.3 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.

.4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 Protection

.1 Cover tops of completed and partially completed walls with waterproof coverings at end of each working day. Drape covers over walls and extend 600 mm down both sides. Anchor securely in position.

.2 Protect adjacent finished surfaces from marking or damage due to masonry Work.

.3 Provide temporary bracing of masonry Work during erection to prevent damage due to winds or other lateral loads until permanent structure provides adequate bracing.

1.6 Storage and Handling

.1 Store materials on Site in a manner to prevent damage. Store brick veneers off the ground.

.2 Protect all materials from damage due to weather conditions.

.3 Handle materials carefully to prevent chipping and breaking.

.4 Replaced defective or damaged materials with new.

1.7 Site Conditions

.1 Ambient conditions: assemble and erect components only when temperature is above 4°C.

2. PRODUCTS

2.1 Manufactured Units

.1 Match face brick of existing building.

.2 Colour:

.1 Integrally coloured pre-finished architectural concrete block with one or more faces ground to expose variegated colours of natural aggregates.

.2 Colour 591 “Manitoba Stone”.

.3 Colour 606 “Brick Red”.

.3 Reinforcement:

.1 Reinforcement in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

.4 Connectors:

.1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

.5 Flashings:

.1 Flashing: in accordance with Section 04 05 23 - Masonry Accessories.

.6 Mortar Mixes:

.1 Mortar and mortar mixes in accordance with Section 04 05 12 - Masonry Mortaring.

.7 Grout Mixes:

.1 Grout and grout mixes in accordance with Section 04 05 12 - Masonry Mortaring.

.8 Cleaning Compounds:

.1 Compatible with substrate and acceptable to masonry manufacturer for use on products.

.2 Cleaning compounds compatible with brick masonry units and in accordance with manufacturer's written recommendations and instructions.

3. EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for brick masonry 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 Preparation

.1 Protect adjacent finished materials from damage due to masonry work.

3.3 Installation

.1 Construction to conform to CAN/CSA-A371.

.2 Bond: to match existing.

.3 Coursing height: as indicated.

.4 Jointing: to match existing where exposed or where paint or similar thin finish coating is specified.

.1 Mixing and blending: mix units within each pallet and with other pallets to ensure uniform blend of colour and texture.

.2 Clean unglazed clay masonry as work progresses.

.3 Reinforcement:

.1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

.4 Connectors:

.1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

.5 Flashings:

.1 Install flashings in accordance with Section 04 05 23 - Masonry Accessories.

.6 Mortar Placement:

.1 Place mortar in accordance with Section 04 05 12 - Masonry Mortaring.

.7 Grout Placement:

.1 Place grout in accordance with Section 04 05 12 - Masonry Mortaring.

.8 Repair/Restoration:

.1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

.9 Field Quality Control:

.1 Site Tests, Inspection: in accordance with Section 04 05 00 - Common Work Results for Masonry supplemented as follows:

.2 Manufacturer's Field Services: in accordance with Section 04 05 00 - Common Work Results for Masonry.

.10 Tolerances:

.1 To CAN/CSA-A371 unless noted below.

3.4 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

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

.2 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.

.3 Clean unglazed clay masonry: 10 m^2 area of wall designated by Contract Administrator [mock up panel specified in Section 04 05 00 - Common Work Results for Masonry as directed below and leave for one (1) week. If no harmful effects appear and after mortar has set and cured, protect windows, sills, doors, trim and other work, and clean brick masonry as follows.

.1 Remove large particles with wood paddles without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.

.2 Scrub with solution of 25 ml trisodium phosphate and 25 ml household detergent dissolved in 1 L of clean water using stiff fibre brushes, then clean off immediately with clean water using hose. Alternatively, use proprietary compound recommended by brick masonry manufacturer in accordance with manufacturer's directions.

.3 Repeat cleaning process as often as necessary to remove mortar and other stains.

.4 Use acid solution treatment for difficult to clean masonry as described in Technical Note No. 20 by the Brick Industry Association.

.4 Clean concrete brick masonry as work progresses.

.1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of brick and finally by brushing.

.5 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.6 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

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

3.5 Protection

.1 Brace and protect brick masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Concrete Block Masonry.

.2 Concrete Block Masonry Veneer.

.3 Installation of Masonry Accessories.

1.2 Standards

.1 CSA A165 Series, Standards on Concrete Masonry Units.

.2 Perform masonry Work to CSA S304.1, CSA A370, and CSA A371 except where specified otherwise.

.3 Conform to National Building Code of Canada 2010 and the Manitoba Amendments.

1.3 Shop Drawings

.1 Submit Shop Drawing for the temporary bracing of the masonry walls used in the Work.

.2 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

.3 Clearly indicate sizes, connections, attachments, reinforcing, anchorage, size, and type of fasteners and accessories.

.4 Include erection drawings, elevations, and details where applicable.

.5 Shop Drawings and design briefs are to be signed and sealed by a Professional Engineer registered in the Province of Manitoba.

1.4 Cold Weather Requirements

.1 Conform to weather protection requirements in CSA A371.

.2 Masonry units shall be warmed to minimum 5°C prior to install.

1.5 Protection

.1 Cover tops of completed and partially completed walls with waterproof coverings at end of each working day. Drape covers over walls and extend 600 mm down both sides. Anchor securely in position.

.2 Protect adjacent finished surfaces from marking or damage due to masonry Work.

.3 Provide temporary bracing of masonry Work during erection to prevent damage due to winds or other lateral loads until permanent structure provides adequate bracing.

1.6 Storage and Handling

.1 Store materials on Site in a manner to prevent damage. Store masonry units off the ground.

.2 Protect all materials from damage due to weather conditions.

.3 Handle materials carefully to prevent chipping and breaking.

2. PRODUCTS

2.1 Materials

.1 Standard Concrete blocks: to CSA A165.1, normal weight and light weight as shown in the drawing, type H/15/A/M – units to be manufactured by Expocrete or approved equal in accordance with B7.

.1 Dimensions: modular size of 200/250W x 200H x 400L, refer to Drawings for locations of different sizes and weights.

.2 Special shapes: provide Type H/15/A/M bull-nosed units for exposed corners. Provide purpose made shapes for lintels (U-blocks) and bond beams (Knockout Blocks). Provide additional special shapes as indicated or required.

.2 Veneer Concrete Masonry Units: to CSA A165.1, normal weight, type H/15/A/M, units to be manufactured by Expocrete or approved equal in accordance with B7.

.1 Dimensions: Modular size of 100 W x 200 H x 400 L.

.2 Special Shapes: Provide L-Corner units for exposed corners. Provide additional special shapes as indicated.

.3 Profile:

.1 Full Split Face.

.2 Smooth Face.

.4 Colour:

.1 Integrally coloured pre-finished architectural concrete block with one or more faces ground to expose variegated colours of natural aggregates.

.2 Colour 591 “Manitoba Stone”.

.3 Colour 606 “Brick Red”.

.3 Exposed Faces:

.1 Notwithstanding visual inspection requirements of CSA Standards, masonry units shall be free of surface indentations, surface cracks due to manufacture or chipping. Units so delivered shall not be used.

2.2 Cleaning Compounds

.1 Use low VOC products.

.2 Compatible with substrate and acceptable to masonry manufacturer for use on products.

.3 Cleaning compounds compatible with concrete unit masonry and in accordance with Manufacturer's written recommendations and instructions.

2.3 Tolerances

.1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA A165.1, supplemented as follows:

.1 Maximum variation between units within specific job lot not to exceed 2 mm.

.2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.

.3 Out of square tolerance not to exceed 2 mm.

3. EXECUTION

3.1 Workmanship

.1 Build masonry Work true-to-line, plumb, square, and level, with vertical joints in proper alignment.

.2 Tolerances for exposed masonry Work shall be:

.1 Variation from mean plane: 3 mm under 2500 mm straight edge.

.2 Variation in masonry openings: 6 mm maximum.

.3 Variation from plumb: 9 mm in 6 m.

.3 Assume complete responsibility for dimensions, plumbs, and levels of this Work and constantly check same with graduated rod.

.4 Masonry courses to be of uniform height, and both vertical and horizontal joints to be of equal and uniform thickness.

.5 Construct walls upward in a uniform manner, no one portion being raised more than 1200 mm above another at any time.

.6 Buttering corners of units, throwing mortar into joints, and deep or excessive furrowing of bed joints will not be permitted. Do not shift or tap units after mortar has taken initial set. Where adjustments must be made after mortar has started to set, remove mortar and replace with fresh supply.

3.2 Blockwork

.1 Lay concrete block in running bond, with thicker end of face shell upward. Coursing to be modular 200 mm for one block and one joint.

.2 Use special shaped units where indicated, specified, or required. Use bull-nosed units for exposed external corners at door and window jambs. Exposed open cells not permitted.

.3 Concrete masonry units shall have face shells and their end joints fully filled with mortar, and joints squeezed tight. Also fill webs at cores, to be reinforced and grouted, and strike flush at core taking care to prevent mortar from falling into core.

.4 Tie intersecting non-bearing walls together with masonry reinforcing every second course.

.5 Do not tie intersecting bearing walls together in masonry bond, except at corners.

3.3 Mortar and Pointing

.1 Make all joints uniform in thickness, straight, in line, and with mortar compressed to form concave joints.

3.4 Building In

.1 Build in door and window frames, steel lintels, sleeves, anchor bolts, anchors, nailing strips, and other items to be built into masonry.

.2 Do not distort metal frames. Bed anchors of frames in mortar and fill frame voids with mortar or grout as walls are erected.

3.5 Bearings

.1 Fill concrete block solid with 20 MPa concrete for two cores and two (2) courses below bearing points of structural members unless indicated otherwise on the Drawings.

3.6 Masonry Reinforcing

.1 Concrete block walls and partitions shall be continuously reinforced and tied together with masonry reinforcing in every second block bed joint.

.2 Place masonry joint reinforcing in first and second bed joints above and below openings. Reinforcing in first bed joint shall be continuous. Second bed joint reinforcing shall extend 600 mm beyond each side of opening.

.3 Place continuous reinforcing in second bed joint below the tops of walls.

.4 Lap reinforcement minimum of 150 mm at splices and cut and bend corners.

.5 Vertical reinforcing bars to be continuous into lintels, through intermediate bond beams, and extend into the top most wall bond beam for the bond beams fully height minus 50 mm. Fill cores with 20 MPa concrete.

3.7 Cutting Masonry

.1 Cutting of masonry units exposed in finished Work is to be done with accepted type power saw. Where electrical conduit outlets and switch boxes occur, grind and cut units before services are installed.

.2 Obtain the Contract Administrator's permission before cutting any part of area which may impair appearance or strength of the Work.

.3 Patching of masonry is not permitted without the Contract Administrator's authorization.

3.8 Bond Beams

.1 Install concrete block bond beams where indicated and where required for bearing of structural members.

.2 Make bond beams of knockout blocks with two (2) 15M reinforcing bars and fill with 20 MPa concrete.

.3 Provide 200 mm high bond beam at 2400 mm maximum vertical spacing.

3.9 Reinforced Block Lintels

.1 Install reinforced concrete block lintels over openings as indicated on the Drawings using 20 MPa concrete.

.2 Cast and cure lintels on plank. Set special channel lintel blocks using specified mortar. Place wood stops at either end of lintel to prevent movement.

.3 Place 25 mm of concrete in voids, place in deformed reinforcing bars and place concrete to level of block sides. Rod and tamp concrete well without disturbing reinforcing. Allow lintels to cure seven (7) days before removing shores.

.4 Minimum bearing shall be 400 mm each side of openings.

3.10 Provisions for Other Trades

.1 Provide openings in masonry walls where required or indicated.

.2 Accurately locate chases and openings and neatly finish to required sizes.

.3 Where masonry encloses conduit, ducts, and piping, bring to proper level indicated and as directed. Do not cover any pipe or conduit chases or enclosures until advised that Work has been reviewed and tested.

.4 Build masonry neatly around conduit, ducts, sleeves, and piping passing through.

3.11 Cleaning

.1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block and finally by brushing.

.2 Scrub surfaces to be cleaned using non-acid cleaning solution of type that will not harm constructed masonry. Check masonry unit Manufacturer for acceptable solution. Clean trial test area and obtain permission to proceed.

.3 Use large amounts of water and do cleaning in accordance with solution Manufacturer's instructions.

.4 Point or replace defective mortar to match existing as required or directed.

.5 Repeat cleaning operations as often as necessary until Work is satisfactory.

END OF SECTION

STRUCTURAL STEEL FOR BUILDINGS

1. GENERAL

1.1 References

.1 ASTM International Inc.:

.1 ASTM A 36/A 36M, Standard Specification for Carbon Structural Steel.

.2 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 414 MPa Tensile Strength.

.3 ASTM A 325M, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength Metric.

.4 ASTM A 490M, Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints Metric.

.5 ASTM F 1554, Standard Specification for Anchor Bolts, Steel 36, 55 and 105 ksi.

.2 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.

.3 CISC/CPMA Standard 1-73a – A Quick-Drying One-Coat Paint for Use on Structural Steel.

.3 Canadian Standards Association (CSA International):

.1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA-S16, Limit States Design of Steel Structures.

.3 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.4 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.

.5 CSA W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.6 CSA W59, Welded Steel Construction (Metal Arc Welding).

.4 The Society for Protective Coatings (SPC) and National Association of Corrosion Engineers (NACE) International 299:

.1 SSPC-SP3, Power Tool Cleaning.

.2 SSPC SP6/ NACE No. 3, Commercial Blast Cleaning.

.3 SSPC-PA 1, Shop, Field, and Maintenance Painting of Steel.

1.2 Action and Informational Submittals

.1 Submit in accordance with Submittal Procedures set out in Division 1. “Engineered” denotes Shop Drawing submittal requirements and shall be prepared, signed and sealed by a (Specialty) professional structural engineer registered or licensed in Province of Manitoba, Canada and having a minimum of five (5) years proven experience in this type of Work.

.1 Specialty Engineer to submit Certification Letter of Assurance of “professional design” and commitment for “field review” which shall be included with the Shop Drawing submittals.

.2 Structural Calculations:

.1 Where requested, submit structural calculations sealed by the Specialty Engineer. This shall include:

.1 Description of design criteria adopted.

.2 Summary of engineering analysis showing maximum stresses and deflections.

.2 Erection drawings:

.1 Prepare and submit erection drawings in PDF format for the Contract Administrator’s review based on issued for construction drawings to show:

.1 General arrangement with principal dimensions of the structures.

.2 Elevation and detail sections.

.3 Piece marks and sizes of members.

.4 Size, number and type of bolts for the connections.

.5 Necessary dimensions and details for setting anchor rods.

.2 Submit an assurance letter stamped and signed by the Specialty Engineer.

.3 Connection Details:

.1 Prepare, design and submit connection design details in advance of the shop details to the Contract Administrator for confirmation that the design intent is met based on the structural layout and connection forces shown on the construction drawings. The design details are to include both standard and non-standard connections and are to be referenced to the design drawings and/or erection drawings.

.4 Shop Details:

.1 Prepare and submit for record shop details based on the issued construction drawings, the accepted erection drawings and connection design details. The shop

details shall be complete with information necessary for fabrication of various members and components of the structure including:

.1 Material grade and standards.

.2 Member size and geometry.

.3 Details and sections.

.4 Connection: mechanical fasteners and welds.

.5 Location, type and size of all attachments.

.5 Field Work Details:

.1 Where fabricated members require modification on the job site, submit field work details to the Contract Administrator for review and prior approval. The details are to be stamped and signed by the Specialty Engineer.

.6 Source Quality Control Submittals:

.1 Submit PDFs of mill test reports:

.1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.

.2 Where requested, provide mill test reports certified by metallurgists qualified to practice in the Province of Manitoba, Canada.

.3 Field Review and Inspection Reports:

.1 Specialty Engineer to submit Certification Letter or Letter of Assurance of “professional field review” and “compliance” in accordance with the agreed Field Quality Control. Inspection reports to be issued to the Contract Administrator and structural engineer of record concurrently at each inspection.

1.3 Delivery, Storage and Handling

.1 Delivery and Acceptance Requirements: Deliver steel in accordance with same label marks as used for fabrication and erection documents.

.2 Storage and Handling Requirements: Protect steel from corrosion, deformation and other damage during site storage and handling. Protect other sections of the Work from damage by this Section.

2. PRODUCTS

2.1 Design Requirements

.1 Design details and connections in accordance with requirements of 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 that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.

.3 Submit sketches and design calculations stamped and signed by qualified Professional Engineer licensed in the Province of Manitoba, Canada for non-standard connections.

2.2 Materials

.1 Structural steel: to CSA-G40.20/G40.21 with minimum grade as per Drawings.

.2 Anchor bolts: to ASTM F 1554, Grade 36 (with minimum yield strength = 248 MPa and tensile strength = 400 Mpa).

.3 Bolts, nuts and washers: to ASTM A 325M, A563M and F436M.

.4 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.

.5 Shop paint primer: refer to Structural Steel Notes on the drawings and Metal Finishing Specifications.

.6 Hot dip galvanizing: galvanize steel, where indicated, to CSA-G164, minimum zinc coating of 600 g/m^2.

2.3 Fabrication

.1 Fabricate structural steel in accordance with CSA-S16 and in accordance with reviewed Shop Drawings.

.2 Hot Dip Galvanize all structural steel and attached components to ASTM A123M for shapes and ASTM A153 for hardware.

.3 Do not place any holes or openings in structural steel members.

3. EXECUTION

3.1 Application

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 General

.1 Structural steel work: in accordance with 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.

3.3 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.

3.4 Erection

.1 Erect structural steel, as indicated and in accordance with CSA-S16 and in accordance with reviewed erection drawings.

.2 Make adequate provision for all erection loads and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of necessary permanent bracing.

.3 Set column base plates on steel wedges or shims to accurate elevations. Wooden wedges are not permitted.

.4 Do not field cut or alter structural members. Report to the Professional of Record and Contract Administrator every failure of material to fit together properly. Corrective measures to be approved by the Professional of Record.

.5 Continuously seal members by continuous welds where indicated. Grind smooth.

.6 Repair damaged galvanizing to ASTM A780M with zinc-rich paint equivalent to Galvacon applied in multiple coats to a minimum dry film thickness of 0.20 mm.

3.5 Field Quality Control

.1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Contract Administrator and paid for by the Contractor.

.2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Contract Administrator.

.3 Submit test reports to Contract Administrator within one (1) week of completion of inspection.

3.6 Cleaning

.1 Clean work area at job Site.

END OF SECTION

STEEL JOIST FRAMING

1. GENERAL

1.1 References – Latest Edition

.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, Design of Steel Structures.

.3 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.4 CSA W55.3, Certificate of Companies for Resistance Welding of Steel and Aluminum.

.5 CSA W59, Welded Steel Construction (Metal Arc Welding).

1.2 Action and Informational Submittals

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

.2 Shop Drawings:

.1 Submit drawings stamped and signed by Professional Engineer registered and licensed in the Province of Manitoba.

.2 Indicate on erection drawings, relevant details such as joist mark, depth, spacing, bridging lines, bearing, anchorage and details.

.3 Indicate particulars, on shop drawings, relative to joist 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.

.3 Delegated Design Submittals:

.1 Submit copies of calculations and joist design drawings for typical joists to Contract Administrator for review minimum four (4) weeks before fabrication and delivery.

1.3 Quality Assurance

.1 Submit copies of mill test reports minimum four (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.

1.4 Delivery, Storage and Handling

.1 Delivery and Acceptance Requirements: deliver materials to Site in original factory packaging, labelled with manufacturer's name and address.

.2 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.

2. PRODUCTS

2.1 Design Criteria

.1 Design steel joists and bridging to carry loads indicated on structural drawings to CSA S16.

.2 Design joists and anchorages for gross uplift forces as 1.60 kPa.

.3 Manufacture joists to consider load effects due to fabrication, erection and handling.

.4 Limit roof joist deflection due to specified live load to 1/360 maximum of span and deflection due to specified total load to 1/240 maximum of span.

2.2 Materials

.1 Open web steel joists: to CSA S16.

.2 Structural steel: to CSA G40.20/G40.21.

.3 Welding materials: to CSA W59.

.4 Shop paint primer: zinc chromate shop primer to CAN/CGSB-1.40.

.5 Shear studs: to CSA W59, Appendix H.

2.3 Fabrication

.1 Fabricate steel joists and accessories as indicated in accordance with CSA S16 and in accordance with approved Shop Drawings.

.2 Weld in accordance with CSA W59.

.3 Provide diagonal and horizontal bridging and anchorages as indicated.

.4 Install shear studs in accordance with CSA W59.

2.4 Shop Painting

.1 Clean, prepare and shop prime surfaces of steel joists to CSA S16.

.2 Clean members of loose mill scale, rust, oil, dirt and other foreign matter. Prepare surfaces to SSPC SP7 brush-off blast cleaning.

.3 Apply one (1) coat of zinc chromate shop primer to CAN/CGSB-1.40 to steel surfaces to achieve dry film thickness of 0.065 mm to 0.080 mm maximum except:

.1 Surfaces to receive site installed stud shear connectors and steel decks.

.2 Surfaces and edges site welded.

.3 Faying surfaces of friction-type connections.

.4 Apply paint under cover, on dry surfaces, when surface and air temperatures are minimum 5°C.

.5 Maintain dry condition and 5°C minimum temperature until paint thoroughly dry.

.6 Strip paint bolts, nuts, sharp edges and corners before prime coat dries.

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 and bridging as indicated to CSA S16 and in accordance with approved erection drawings.

.6 Complete installation of bridging and anchorages before placing construction loads on joists.

.7 Site cutting or altering joists or bridging: to approval of Contract Administrator.

.8 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 seven (7) days after completion of inspection.

.4 Trade Contractor will pay costs of tests as specified in Section 01 29 83 - Payment Procedures: Testing Laboratory Services.

.5 Test shear studs to CSA W59.

3.4 Site Painting

.1 Touch up damaged surfaces and surfaces without shop coat with zinc chromate shop primer to CAN/CGSB-1.40 in accordance with manufacturers' recommendations.

3.5 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

STEEL DECKING

1. GENERAL

1.1 References – Latest Edition

.1 ASTM International, (ASTM):

.1 ASTM A 653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.3 Canadian Standards Association (CSA International):

.1 CSA-S136, North American Specification for the Design of Cold Formed Steel Structural Members.

.2 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.3 CSA W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.4 CSA W59, Welded Steel Construction, (Metal Arc Welding).

.4 Canadian Sheet Steel Building Institute (CSSBI):

.1 CSSBI 10M-08, Standard for Steel Roof Deck.

.2 CSSBI 12M-08, Standard for Composite Steel Deck.

1.2 Action and Informational Submittals

.1 Submit Shop Drawings erection and shoring drawings in accordance with Section 01 33 00.

.2 Submit drawings stamped and signed by qualified Professional Engineer registered and licensed in the Province of Manitoba.

.3 Submit design calculations if requested by Contract Administrator.

.4 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories. Show welding and connection details for diaphragm action.

.5 Indicate details of temporary shoring of steel deck, such as location, time and duration of placement and removal of shoring for concrete fill decks.

1.3 Quality Assurance

.1 Steel deck manufacturers: members in good standing of the Canadian Sheet Steel Building Institute.

1.4 Warranty

.1 Contractor hereby warrants the Work of this Section for five (5) year from the date of the Interim Certificate of Completion.

2. PRODUCTS

2.1 Design Requirements

.1 Design steel deck using limit states design in accordance with CSA S136, CSSBI 10M and CSSBI 12M.

.2 Steel decking and all connectors/fasteners shall be designed to safely carry dead, live and diaphragm loads as indicated, including any variable or concentrated loads, wind uplift and construction loads. Where no diaphragm loads are indicated on design drawings, design steel deck and connections to steel framing for a factored diaphragm load of 5.0 kN/m in each direction.

.3 Deflection under specified live loads (including construction loads) shall not exceed 1/360 of span.

2.2 Materials

.1 Zinc (Z) coated steel sheet to ASTM A 653/A653M structural quality Grade 230, with Z275 coating, regular spangle extra smooth surface, chemically treated for unpainted finish, not chemically treated for paint finish, 0.76 mm minimum base steel thickness.

.2 Cover plates, cell closures and flashings: steel sheet with minimum base steel thickness 0.76 mm. Metallic coating same as deck material.

.3 Touch-up Primer: zinc rich, ready mix to CAN/CGSB-1.181, zinc rich type.

.1 Maximum VOC Content: 250 g/L (less water).

.4 Shear studs: to CSA W59.

2.3 Types of Decking

.1 Steel roof deck where indicated: steel thickness and deck depth as indicated on the drawings; actual thickness shall be designed by the steel deck designer. Where deck profile and minimum thickness is not shown on structural drawings, provide 38 mm maximum deep profile, non-cellular, interlocking side laps, with deck thickness as designed by deck design engineer; minimum deck thickness shall not be less than 0.76 mm.

.2 Composite steel deck where indicated: steel thickness and deck depth as indicated on the drawings; actual thickness shall be designed by the steel deck designer. Where deck profile and minimum thickness is not shown on structural drawings, provide 38 mm deep profile, non-cellular, upright inverted embossed fluted profile, interlocking side laps, with deck thickness as designed by deck design engineer; minimum deck thickness shall not be less than 0.91 mm. Deck to have deformed webs for composite action.

3. EXECUTION

3.1 General

.1 Structural steel work: in accordance with CAN/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 and/or CSA W55.3 for resistance welding.

3.2 Erection

.1 Erect steel deck as indicated and in accordance with CAN/CSA S136, CSSBI 10M, CSSBI 12M and reviewed Shop Drawings.

.2 Tolerances: lay and position deck within a tolerance of 10mm with respect to edges of deck parallel to flutes and centerlines of supporting structure.

.3 Provide anchor plates where deck bears on masonry and/or concrete.

.4 Lap ends: 50 mm minimum unless noted.

.5 Deck connections:

.1 To supporting steel beams or joists: Hilti X-ENP/X-HSN24 or approved alternate, 36/7 fastener pattern.

.2 At deck sidelaps: #10 screw @ 600 o/c.

.3 At perimeter of building: Hilti X-ENP/X-HSN24 or approved alternate at 150 o/c.

.6 Weld and test shear stud connectors through steel deck to steel beams, joists or wall plates below as indicated on the Drawings, or as required under the Work of other Sections.

.7 Immediately after decking is permanently secured in place, touch up surface with compatible primer where burned by welding, or otherwise damaged.

.8 Reinforce openings to CSSBI Standards, or as indicated on the Drawings.

.9 Provide cover plates, cell closures and flashing, where indicated or required.

.10 No ceiling, lighting, sprinkler pipe, ductwork, electrical conduit or other item shall be hung from steel deck, unless shown on the Drawings.

.11 Provide solid blocking between the flutes of the roof deck and supporting members, where additional load due to sleepers or curbs at roof top equipment is placed on the roof deck.

.12 Upon completion of erection remove dirt and debris from deck.

.13 Provide metal flashing to form edges of slab and trimmers around openings, where steel angles not provided under the Work of Section 05 12 23.

.14 Prior to concrete placement, steel deck to be free of soil, debris, standing water, loose mil scale and other foreign matter.

.15 Temporary shoring, if required, to be designed to support construction loads, wet concrete and other construction equipment. Do not remove temporary shoring until concrete attains 75% of its specified twenty-eight (28) day compression strength.

.16 Place and support reinforcing steel as indicated.

3.3 Openings and Areas of Concentrated Loads

.1 No reinforcement required for openings cut in deck which are smaller than 150 mm square.

.2 Frame deck openings with any one dimension between 150 and 300 mm as recommended by manufacturer, except as otherwise indicated.

.3 For deck openings with any one dimension greater than 300 mm and for areas of concentrated load, reinforce in accordance with structural framing details.

3.4 Connections

.1 Provide connections in accordance with CSSBI recommendations as indicated.

3.5 Defective Work

.1 Remove and replace, or repair, damaged or defective work, at no cost to the Contract.

.2 Submit in writing, details of proposed method of remedial work, for approval by the Contract Administrator. Details to be signed and sealed by a licensed Professional Engineer retained by the Contractor.

END OF SECTION

METAL FABRICATIONS

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Steel angle lintels.

.2 Pipe railings.

.3 Pipe bollards.

.4 Metal ladders/ Crossover stair.

.5 Sump pit cover and frame.

.6 Sewer drain cover and frame.

.7 Door frames.

.8 Crossover stairs.

.2 Related Requirements:

.1 Section 03 30 00 - Cast-in-Place Concrete, for installation of anchors in concrete.

1.2 Administrative Requirements

.1 Coordination:

.1 Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

.2 Coordinate installation of anchorages for metal fabrications. 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 such items to Project site in time for installation.

1.3 Action and Informational Submittals

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

.2 Shop Drawings:

.1 Include plans, elevations, sections, details, and attachments to other work.

.2 Indicate materials, core thickness, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.

.3 Indicate field measurements on Shop Drawings.

.3 Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer registered in Manitoba responsible for their preparation.

1.4 Quality Assurance

.1 Welding Qualifications: Qualify procedures and personnel according to the following:

.1 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.2 CSA W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

1.5 Delivery, Storage and Handling

.1 Waste Management:

.1 Deposit packaging materials in appropriate container on site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

1.6 Project Conditions

.1 Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

2. PRODUCTS

2.1 Design and Performance Requirements

.1 Delegated Design: Design railings, guards, and ladders including comprehensive engineering analysis by qualified professional engineer, using performance requirements, criteria indicated.

.2 Design Requirements:

.1 Design ladder assembly including mounting brackets and attachments to support a uniform live load of 3.5 kg/m^2 and a concentrated load of 10 kg/m^2 to ANSI A14.3.

.2 Design hand railings, guards, and connections to support minimum horizontal live load 0.75 kN/m or a concentrated load of 1.0 kN.

.3 Design hand railings, guards, connections to support minimum vertical live load 1.5 kN/m.

.4 Design items of sufficient strength and rigidity to safely withstand stresses encountered in normal use. Unless specified or noted otherwise, imposed live loads shall be in accordance with National Building Code.

.3 Performance Requirements:

.1 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling,

opening of joints, overstressing of components, failure of connections, and other detrimental effects.

.1 Temperature Change: 80°C, ambient; 100°C, material surfaces.

2.2 Components, General

.1 Examine the Drawings and Specifications and provide metal fabrication items required for the proper execution of this project.

.2 Items described herein do not necessarily indicate the full scope of Work of this Section. Provide all metal fabrication items that are not clearly the responsibility of other trades.

.3 Details and Specifications are intended to indicate general character and extent of metal fabrications and do not attempt to indicate all methods of construction.

.4 Items shall conform to detail and material indicated on the Drawings or in the Specifications. Supply items listed, but not specifically detailed or specified, as standard stock items, conforming to accepted standards of such work.

.5 Stock commercial items conforming substantially in design, material and fabrication to items detailed on plans or specified will be considered as equal upon prior written approval by the City.

2.3 Materials

.1 Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

.2 Steel Sections and Plates: to CAN/CSA-G40.21, Type 300W.

.3 Steel Pipe: to ASTM A53/A53M, standard weight, schedule 40 seamless black.

.4 Welding Materials: to CSA W59.

.1 Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

.5 Bolts and Anchor Bolts: to ASTM A307.

.6 Post-installed anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

.7 Non-premixed dry pack grout: composition of non-metallic aggregate Portland cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 40 MPa at twenty-eight (28) days.

2.4 Fabrication, General

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof oval headed screws on items requiring assembly by screws or as indicated.

.3 Use welded connections exterior metal work unless otherwise approved by the Contract Administrator.

.4 Where possible, fit work and shop assemble, ready for erection.

.5 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

.6 Seal exterior steel fabrications to provide corrosion protection.

.7 Exposed fastenings: same material, colour and finish as metal to which applied unless indicated otherwise.

.8 Supply items complete with fastenings.

.9 Remove and grind smooth burrs, filings, sharp protrusions, and projections from metal fabrications to prevent possible injury. Correct dangerous or potentially harmful installations as directed by the City.

.10 Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

.11 Seal exterior steel fabrications to provide corrosion protection in accordance with CAN/CSA-S16.1.

2.5 Steel Angle Lintels

.1 Steel angles: Sizes indicated for openings. Provide minimum 150 mm bearing at ends.

.2 Weld or bolt back-to-back angles to profiles indicated.

.3 Where lintel sizes are not specifically indicated, provide steel angle lintels in accordance with the following:

Openings Size	Angle Size for Each 100 mm Masonry
Up to 1200 mm	90 by 90 by 8 mm
1200 to 1500 mm	100 by 90 by 8 mm
1500 to 1800 mm	125 by 90 by 8 mm
1800 to 2150 mm	125 by 90 by 12 mm
Over 2150 mm	180 by 100 by 11 mm

.4 Finish: galvanized.

2.6 Pipe Railings

.1 Steel pipe: standard weight, nominal outside diameters indicated. Formed to shapes and sizes indicated. Return pipe railing to walls at terminations.

.2 Cap open ends of railings with half-round welded steel plate.

.3 Wall brackets: steel bar formed to sizes and profiles indicated. Provide wall brackets at maximum 1200 mm on centre and not more than 300 mm from ends and corners.

.4 Finish:

.1 Exterior railings: Galvanize, after fabrication.

.2 Interior railings: Shop coat prime paint after fabrication.

2.7 Pipe Bollards

.1 Steel pipe: extra strong, nominal outside diameter indicated.

.2 Finish: Prime paint above grade for site painting.

2.8 Metal Ladders

.1 Stringers: steel pipe, standard weight, nominal outside diameter indicated, formed to sizes and profiles indicated. Cap off open ends of pipe stringers with half-round welded steel plate.

.2 Rungs: 20 mm diameter steel bar, let in and welded to stingers.

.3 Brackets: sizes and shapes indicated, welded to stringers at maximum 1200 mm centre to centre, complete with fixing anchors.

.4 Finish:

.1 Exterior ladders: Galvanize, after fabrication.

.2 Interior ladders: Prime paint after fabrication.

2.9 Sump Pit Cover and Frame

.1 Frame: steel angle 40 by 40 by 5 thick continuous around perimeter of pit. Mitre and weld frame corners. Provide with steel strap anchors welded to underside of angles for setting in concrete.

.2 Cover: 6 mm thick steel checker plate. Provide cover in two pieces with lift rings for each piece. Coordinate with Division 22 and provide openings and cut-outs in cover for mechanical piping.

.3 For sewage pits provide neoprene rubber gaskets around full perimeter of frame.

.4 Finish: Prime paint cover and frame.

2.10 Sewer Drain Covers and Frames

.1 Frame: steel angle 50 by 50 by 6 thick, continuous around perimeter of trench drains and grit interceptor pits. Mitre and weld frame corners. Provide with steel strap anchor at 300 mm on centre welded to frame for embedding in concrete.

.2 Cover:

.1 Metal bar grating to ANSI/NAAMN MBG 531, steel, smooth edges. Hot dipped galvanized.

.2 Trench drains: W-19-4 bearing bars 45 by 4.8 mm at 30 mm on centre. Bearing bars 100 mm on centre. Provide in maximum 1200 mm lengths for lifting.

.3 Interceptor pits: W-19-4 bearing bars 45 by 4.8 mm at 30 mm on centre. Bearing bars 100 mm on centre. Provide in single piece for each pit.

.3 Finish: Hot dip galvanized gratings and frames.

2.11 Overhead Door Frames

.1 Fabricate frames from steel channels angles and plates, to sizes and profiles indicated.

.2 Weld sections together to form continuous frame for jambs and head of openings, sizes as indicated.

.3 Weld steel strap anchors to channel jamb frame at 600 mm on centre for setting in masonry.

.4 Coordinate with overhead door supplier and provide steel plate jamb extensions and wall plates for mounting overhead door and hardware.

.5 Finish: prime coat painted.

2.12 Finishes, General

.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

.2 Finish metal fabrications after assembly.

.3 Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

.4 Provide exposed fasteners with finish matching appearance, including colour and texture, of railings. Stainless steel fittings shall have matching stainless steel fasteners.

2.13 Finishes

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m2 to CAN/CSA-G164.

.2 Shop Primers: Provide primers that comply with Section 09 91 00 – Painting.

.3 Shop coat primer: to CAN/CGSB-1.40, rust-inhibitive, high solids, low VOC, grey.

.4 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181, and compatible with topcoat.

.5 Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it. Maximum VOC content – 250 g/L (less water).

2.14 Shop Finishing

.1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2.

.1 SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

.2 SSPC-SP 3, "Power Tool Cleaning."

.2 Primer:

.1 Apply one (1) coat of shop primer except on surfaces to be clear coated, interior surfaces of pans, and to parts inaccessible after final assembly.

.2 Apply two (2) coats of primer of different colours to parts inaccessible after final assembly.

.3 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease, do not paint when temperature is below 7°C.

.3 Do not paint surfaces to be field welded.

3. EXECUTION

3.1 Installation, General

.1 Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

.2 Install exterior metal fabrications and other components using galvanized anchors, bolts and washers.

.3 Install metalwork in accordance with reviewed Shop Drawings.

.4 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.5 Provide suitable means of anchorage acceptable to the City such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.6 Exposed fastening devices to match finish and compatible with material through which they pass.

.7 Provide components for building by other sections in accordance with Shop Drawings and schedule.

.8 Make field connections with bolts to CAN3-S16.1-M, or weld.

.9 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

3.2 Pipe Railings

.1 Attach handrails to wall with wall brackets. Provide bracket with 50 mm clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:

.1 For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

.2 For hollow masonry anchorage, use toggle bolts.

.3 For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

3.3 Pipe Bollards

.1 Set pipe level and plumb into reinforced concrete footing. Fill pipe with concrete and round over concrete at top of pipe.

.2 Concrete Type 50 sulphate resistant, 20 MPa to Section 03 30 00 - Cast-In-Place Concrete.

3.4 Metal Ladders

.1 Install ladders in locations as indicated.

.2 Erect ladders 150 mm clear of wall on bracket supports.

.3 Mount ladders for elevator pits to governing codes and regulations.

3.5 Sewer Drain Covers

.1 Set top of angle frame flush with adjacent concrete surface.

3.6 Drains and Grit Interceptors

.1 Set angle frame flush with adjacent slab surface.

.2 Install grating using saddle clips allowing grating removal.

3.7 Door Frames

.1 Install steel frames to openings as indicated. Anchor securely to adjacent construction.

3.8 Cleaning

.1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.

.2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

.3 Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

.1 Apply by brush or spray to provide a minimum 0.05-mm dry film thickness.

.4 Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION

ROUGH CARPENTRY

1. GENERAL

1.1 Summary

.1 Related Requirements:

.1 Section 07 52 00 – Modified Bituminous Roofing.

1.2 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 [wood products and accessories] and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 Quality Assurance

.1 Lumber Identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood Identification: by grade mark in accordance with applicable CSA standards.

.3 Plywood, OSB and wood based composite panel construction sheathing identification: by grade mark in accordance with applicable CSA standards.

.4 For products treated with preservative and fire-retardant by pressure impregnation submit following information certified by authorized signing officer of treatment plant:

.1 Information listed in AWPA M2 and revisions specified in CSA O80 Series, Supplementary Requirement to AWPA M2 applicable to specified treatment.

.2 Moisture content after drying following treatment with water-borne preservative, and fire-retardant.

.3 Acceptable types of paint, stain, and clear finishes that may be used over treated materials to be finished after treatment.

1.4 Delivery, Storage and Handling

.1 Keep materials under cover and dry. Protect from weather and contact with damp surfaces. Provide for air circulation within and around stacks and under temporary coverings.

.2 Waste Management:

.1 Deposit packaging materials in appropriate container on site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

2. PRODUCTS

2.1 Lumber Materials

.1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards:

.1 CAN/CSA-O141.

.2 NLGA Standard Grading Rules for Canadian Lumber.

.2 Machine Stress-Rated Lumber: acceptable for all purposes.

.3 Framing and board lumber: in accordance with NBC.

.4 Furring, Blocking, Nailing Strips, Grounds, and Rough Bucks:

.1 Use S2S or S4S material.

.2 Board sizes: "Standard" or better grade.

.3 Dimension sizes: "Standard" light framing or better grade.

.4 Post and timbers sizes: "Standard" or better grade.

2.2 Panel Materials

.1 Douglas fir plywood (DFP): to CSA O121, standard construction. No added urea-formaldehyde.

.2 Canadian softwood plywood (CSP): to CSA O151, standard construction. No added urea-formaldehyde.

.3 Poplar plywood: to CSA O153, standard construction. No added urea-formaldehyde.

.4 Plywood, OSB and wood based composite panels: to CAN/CSA-O325. No added urea-formaldehyde.

2.3 Accessories

.1 General: In accordance with Part 9 of NBC as supplemented by the following requirements, except where specific type is indicated. Provide nails or screws, in sufficient length, to penetrate not less than 38 mm into wood substrate.

.2 Nails, Spikes and Staples: to ASTM F1667, use common spiral nails and spiral spikes except where indicated otherwise.

.1 Use hot dipped galvanized finish to ASTM A123 for exterior work, interior highly humid areas and for pressure-preservative and fire-retardant treated lumber, except where indicated otherwise.

.3 Bolts: 12 mm diameter unless indicated otherwise, complete with nuts and washers.

.4 Nailing Discs: flat caps, minimum 25mm diameter, minimum 0.4mm thick sheet metal, fibre, formed to prevent dishing. Bell or cup shapes not acceptable.

.5 Exterior Wall Sheathing Paper: to CAN/CGSB-51.32, non-perforated, high quality, non-woven polyolefin type.

.1 Acceptable Products: DuPont Tyvek Commercial Wrap; Typar MetroWrap; Fabrene Inc. Air-Gard XL.

.6 Sill Plate Gasket: Moisture-resistant foam, 6 mm thick by width of framing.

.1 Acceptable Products: Owens Corning FoamSealR Sill Gasket, Protecto Wrap Energy Plate Liner.

.7 Joist Hangers: minimum 1 mm thick sheet steel, galvanized ZF001 coating designation.

.8 Roof Sheathing H-Clips: formed "H" shape, thickness to suit panel material, extruded 6063-T6 aluminum alloy type approved by the City.

2.4 Wood Preservative

.1 Pressure-preservative:

.1 Treat material to CAN/CSA-O80 using alkaline copper quaternary (ACQ) Type C.

.2 Materials: dried after treatment to moisture content of 19% or less.

.3 Each piece of treated material shall be identified with a tag or ink mark bearing the Canadian Wood Preservers' Bureau quality mark.

.4 Pressure preservative treat material as follows:

.1 Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapour barriers, and waterproofing.

.2 Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

.3 Wood framing and furring attached directly to the interior of below-grade concrete walls.

.4 Wood framing members that are less than 460 mm above the ground in crawlspaces or unexcavated areas.

.5 Wood floor plates that are installed over concrete slabs-on-grade.

.6 Other material as indicated.

.2 Surface-applied wood preservative:

.1 Copper napthenate or pentachlorophenal base water repellent preservative. Use clear for materials exposed in final assembly, coloured elsewhere. Maximum VOC content 350 g/L (less water).

3. EXECUTION

3.1 Preparation

.1 Surface apply wood preservative to heartwood of pressure preservative treated wood resulting from cutting, trimming or boring, before installation.

.2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum three (3) minute soak on lumber and one (1) minute soak on plywood.

3.2 Material Usage

.1 Electrical Equipment Mounting Boards:

.1 Plywood, DFP or CSP, G1S or S1S, square edge, 19 mm thick on 19 by 38 mm furring around perimeter and at maximum 300 mm o.c.

3.3 Installation

.1 Comply with requirements of NBC, supplemented by the following paragraphs.

.2 Install members true to line, levels and elevations, square and plumb.

.3 Construct continuous members from pieces of longest practical length.

.4 Install spanning members with "crown-edge" up.

.5 Install roof sheathing in accordance with requirements of NBC.

.6 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.

.1 Align and plumb faces of furring and blocking to tolerance of 1:600.

.7 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

.8 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.

.9 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.

.10 Install sleepers as indicated.

.11 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.12 Countersink bolts where necessary to provide clearance for other work.

.13 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

END OF SECTION

COLD FLUID APPLIED WATERPROOFING

1. GENERAL

1.1 Section Includes

.1 Application of coating system, complete, including surface preparation and finish coat.

1.2 Related Sections

.1 Section 03 30 00 – Cast-in-Place Concrete.

.2 Section 07 92 00 – Joint Sealants.

1.3 Quality Assurance

.1 Applicator of coating system shall have a minimum of three (3) years recent experience in applying coatings to concrete surfaces and shall be an “Authorized Applicator” recognized in writing by the manufacturer of the coating materials.

.2 Prior to commencement of the Work, a minimum 2 m^2 (20 ft^2) mock-up will be installed on Site for each system. This will be viewed by all parties, and only when accepted will Work of same be allowed to proceed. The mock-up will serve as a benchmark for the installation of each system for the entire project.

.3 During job mock-up and initial period of installation, manufacturer of coating system will provide a trained employee to insure proper use and installation of product. Periodic Site visits will also be made during installation to verify continued proper installation.

1.4 Submittals

.1 Submittals to comply with Section 01 33 00 - Submittal Procedures.

.2 Samples: Submit two (2) samples representative of coating system applied to suitable rigid substrate.

.3 Manufacturer’s Literature: Submit two (2) copies of manufacturer’s literature, specifications and application instructions for all products provided.

.4 Attestation: Submit a minimum of five (5) projects of similar nature which have been installed during the last five (5) years, including name, locations and installation date.

.5 Applicator Certificate: Submit “Authorized Applicator” certificate issued to system applicator by coating material manufacturer.

.6 Guarantee Requirements: Upon completion and acceptance of the Work, submit an executed copy of the guarantee.

1.5 Product Delivery and Storage

.1 Deliver materials to job Site in sealed, undamaged containers clearly labelled with name and manufacturing date or batch number.

.2 Store materials according to manufacturer's directions to prevent deterioration due to moisture, heat, cold, direct sunlight or any other causes.

1.6 Job Conditions

.1 Provide temporary traffic barriers and supervision necessary to control traffic during coating operations.

.2 Ensure that surfaces to receive coating products are above 13°C (55°F) and below 29°C (85°F) for a minimum of forty-eight (48) hours prior to installation.

.3 Commencement of installation implies acceptance of the concrete surface as suitable to receive the traffic coating. Contractor must be notified in writing of any deficiency of the concrete surface or if the surface is unacceptable.

.4 Apply coating materials in strict accordance to the manufacturer of coating materials printed application procedures.

.5 Establish appropriate health, safety and environmental protection practices, in consultation with appropriate regulatory authorities, if necessary, to achieve compliance with any existing applicable regulatory requirements prior to use of products.

2. PRODUCTS

2.1 General

.1 All components and products of the coating system shall be manufactured and supplied by a single manufacturer.

2.2 Manufacturer

.1 Basis of Design / Standard of Acceptance: DUOCHEM Inc., 1250 Graham Bell, Boucherville, Quebec J4B 6H5, Telephone 450-655-6421 or 1-888-577-6421. Branch Office: Western Canada 1-877-455-9595.

.2 Substitutions: Permitted.

2.3 Waterproof Coating

.1 Waterproof coating shall consist of a flexible, liquid applied, UV resistant elastometric coating. Available in standard grey or tan colours.

.2 Primer: Duochem 6030. Only required for very porous or damp surfaces.

.3 Waterproof Coating: Resoflex, a two component, flexible polyurethane.

3. EXECUTION

3.1 Inspection

.1 Examine surfaces and conditions under which coating system is to be applied. Moisture content of surfaces and building air temperatures must be within limits recommended by the

coating manufacturer. Do not start work until unsatisfactory conditions have been corrected. Application of materials indicates acceptance of surfaces.

.2 Surfaces shall be free of curing compound membrane, laitance, dust, dirt, grease, oil and other contaminants that may affect proper adhesion of the coating.

.3 Surfaces to receive coating shall be equivalent to a steel trowel finish for new or patched concrete surfaces.

.4 Moisture content of the concrete shall be checked using a Delmhorst moisture meter. Moisture content shall be within green section of concrete scale prior to commencing Work.

.5 Do not apply deck coating system if ambient temperature and surface temperature is below 4°C (41°F) or above 32°C (90°F), or if relative humidity is above 80%.

3.2 Surface Preparation

.1 Thoroughly clean all surfaces to receive coating by steel shotblast, sandblast, or other method in accordance to the manufacturer's instructions.

.2 Remove projections and other conditions that may affect the installation of the coating.

.3 Rout or sawcut all cracks exceeding 1.5 mm (1/16") in width and fill with Duropli sealant. Use materials and methods recommended by the coating manufacturer.

.4 Protect adjacent surfaces, fixtures and equipment with drop cloths or masking as necessary to prevent damage during surface preparation.

.5 Repair all surface spalls and imperfections with Duochem 390 blended with selected aggregates or other patching compound approved by manufacturer.

3.3 Material Preparation

.1 Carefully prepare and mix materials used in coating work in compliance to manufacturer's instructions.

3.4 Flashings

.1 Provide fluid applied integral flashings at all locations where a horizontal surface abuts a vertical surface and at all projections. Resoflex shall be applied over the prepared surfaces at the minimal rate of 600 microns (24 mils) thick and shall extend 10 cm (4") minimum on vertical surfaces.

.2 At projections through concrete slab such as post, pipes, railings, vents, and similar locations of potential movement, install a 1.5 cm (1/2") bead of Duropli sealant, tool form a cove and allow to cure prior to coating.

3.5 Detail Work

.1 Apply Duochem 390 membrane at a minimum thickness of 500 microns (20 mils) for a distance of 5 cm (2") each side of all unfilled visible cracks up to 0.15 cm (1/16") wide, and filled cracks

in concrete surface, control joints and construction joints to receive coating. Allow to dry 8-16 hours before proceeding to the application of the waterproofing membrane.

3.6 Waterproof Coating

.1 Apply Resoflex at a minimum thickness of 600 microns (24 mils). Spread coating evenly over flashing and detailed work.

3.7 Cleaning

.1 Remove remaining materials and debris from site and dispose of according to rules and regulations.

.2 Uncured Resoflex can be cleaned with Duochem 208 or 205 Solvent. Cured materials are unaffected by solvents or any cleaning chemicals; grinding, chipping or scraping required for removal.

END OF SECTION

BOARD INSULATION

1. GENERAL

1.1 Summary

.1 Related Requirements:

.1 Section 04 22 00 - Concrete Unit Masonry, for insulation support.

.2 Section 07 52 00 - Modified Bituminous Membrane Roofing, for roof insulation.

1.2 Action and Informational Submittals

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

.2 Product Data: For each type of product indicated.

1.3 Delivery, Storage, and Handling

.1 Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

.2 Waste Management:

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

2. PRODUCTS

2.1 Acceptable Products

.1 XPS Cavity Wall Insulation: Dow CavityMate, Owens Corning Foamular C-200.

.2 XPS Below-Grade Insulation: Dow Styrofoam SM, Owens Corning Foamular C-300.

.3 XPS High-Compressive Strength Insulation: Dow Styrofoam Highload 40, 60 and 100, Owens Corning Foamular 400, 600 and 1000.

.4 Mineral Wool Insulation: Roxul CavityRock DD, Thermafiber RainBarrier HD Insulation.

2.2 Insulation

.1 Extruded Polystyrene (XPS) Board: to CAN/ULC-S701, Type 4, minimum 140 kPa compressive strength, thickness indicated, shiplap edges. Thermal resistance per 25 mm thickness minimum 0.86 m2C/W when tested in accordance with ASTM C177 or ASTM C518. Board size: 610 by 2440 mm.

.2 Extruded Polystyrene (XPS) Board - High Compressive Strength: to CAN/ULC-S701, Type 4, minimum 415 kPa compressive strength, thickness indicated, shiplap edges. Thermal

resistance per 25 mm thickness minimum 0.86 m2C/W when tested in accordance with ASTM C177 or ASTM C518. Board size: 610 by 2440 mm.

.3 Mineral-Wool Board: non-combustible, semi-rigid mineral wool fibre insulation board to CAN/ULC-S702, thickness and number of layers indicated. Thermal resistance per 25 mm thickness minimum 0.76 m2C/W when tested in accordance with ASTM C177 or ASTM C518. Maximum moisture absorption 0.07% by weight to ASTM C1104. Board size: 610 by 1219 mm.

2.3 Accessories

.1 Insulation Fasteners:

.1 Steel Substrates:

.1 Mechanically attached impaling pin type anchors with plate welded to projecting pin; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.

.2 Plate: Perforated, galvanized carbon-steel sheet, 0.762 thick by 50 mm square.

.3 Impaling Pin: corrosion-resistance coated, low-carbon steel; fully annealed; 2.67 mm in diameter; length to suit depth of insulation indicated.

.2 Concrete and CMU Substrates: Heat treated carbon steel, zinc plated pin with 60 mm dia. HDPE washer.

.1 Basis of Design: Ramset Insulfast.

.2 Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates[, approved by waterproofing manufacturer for below grade application]. Maximum VOC Content: 50 g/L, less water.

.3 Protection Board:

.1 Above Grade: Pressure-treated DFP or CSP plywood, thickness indicated, as specified in Section 06 10 00 - Rough Carpentry.

.2 Below Grade: 6 mm tempered hardboard.

3. EXECUTION

3.1 Examination

.1 Examine substrates and immediately inform the City in writing of defects.

.2 Before start of work ensure substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

3.2 Installation, General

.1 Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

.2 Install insulation after building substrate materials are dry.

.3 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.4 Maintain 75-mm clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

.5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

.6 Offset both vertical and horizontal joints in multiple layer applications.

.7 Leave insulation board joints unbonded over line of expansion and control joints. Bond continuous 150 mm wide 0.15 mm polyethylene strip over expansion and control joints using compatible adhesive before application of insulation.

.8 Do not enclose insulation until it has been reviewed by the City.

3.3 Perimeter Foundation Insulation

.1 Interior Application: Extend Type 3 XPS insulation board as indicated, installed on inside face of perimeter foundation walls. Install boards using insulation fasteners specified for concrete substrates.

.2 Exterior Application: Extend Type 4 XPS insulation board as indicated. Install on exterior face of perimeter foundation wall with adhesive.

.3 Under Slab Application: Extend Type 4 XPS insulation board as indicated. Loosely lay boards on level compacted fill.

.4 Protection Board:

.1 Cover insulation with protection board where indicated.

.2 Place protection board against insulation starting at bottom with longer dimension horizontal.

.3 Butt sheets. Stagger joints in protection board with joints in insulation.

.4 Continue up wall in similar manner, staggering vertical joints of protection board.

.5 Fasten protection board above grade through insulation into concrete with minimum six (6) fasteners per board.

.6 Loose lay protection board below grade, and hold in place with backfill.

3.4 Rain Screen Wall Insulation With Metal Cladding

.1 Install mineral wool insulation boards on outer surface of inner wythe of wall cavity after air/vapour barrier has been installed and reviewed.

.2 Steel Stud Back-Up:

.1 Mechanically fasten impale fasteners through air/vapour barrier to steel stud framing to provide permanent placement and support of units. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.

.2 Install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.

.3 Concrete or CMU Back-Up: Fasten insulation with mechanical fasteners. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.

.4 Offset joints of second layer of insulation from joints in first layer of insulation.

3.5 Rain Screen Cavity Wall Insulation With Masonry Veneer

.1 Install Type 3 XPS insulation board on outer surface of inner wythe of wall cavity after air/vapour barrier has been installed and reviewed.

.2 Install pads of adhesive spaced approximately 600 mm o.c. both ways, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against substrates.

.3 Adhere second layer of insulation to first layer using manufacturer’s recommended adhesive. Supplement adhesive attachment of insulation by securing boards with insulation support specified in Section 04 22 00 - Concrete Unit Masonry, as part of masonry veneer tie.

.4 Fill voids between boards with foam insulation.

3.6 Cleaning

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

VAPOUR RETARDER

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Above grade vapour retarder.

.2 Underslab vapour retarder.

1.2 Action and Informational Submittals

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

.2 Product Data: for each type of vapour retarder specified. Include material descriptions, performance values demonstrating compliance with specifications, and accessory descriptions.

1.3 Delivery, Storage and Handling

.1 Delivery: Deliver materials to Site in original factory packaging, labelled with manufacturer's name and address

.2 Storage and Handling Requirements:

.1 Store materials off ground and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

.3 Waste Management:

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

2. PRODUCTS

2.1 Sheet Vapour Retarders

.1 Above Grade Vapour Retarder – Drawing No. 9-U2-B502: Polyethylene film to CAN/CGSB-51.34, 0.20 mm thick.

.2 Underslab Vapour Retarder: To ASTM E1745, Class A, maximum 0.56 ng/m^2/s/Pa water vapour permeance to ASTM E 1745 after conditioning to ASTM E154, 0.381 mm thick.

.1 Acceptable Product: Stego Wrap (15 mil) Vapor Barrier, WR Meadows Perminator 15, Layfield VaporFLEX 15.

2.2 Accessories

.1 Joint sealing tape: Air resistant pressure sensitive adhesive tape, type recommended by vapour retarder manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.

.2 Sealant: Acoustical sealant to ASTM C 919, compatible with vapour retarder, acceptable to manufacturer.

.3 Staples: Minimum 6 mm leg.

.4 Moulded box vapour retarder: Factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

3. EXECUTION

3.1 Examination

.1 Examine areas and conditions under which Work is to be performed.

.1 Inform the City of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied.

.2 Verify sub-grade is properly prepared and at correct elevation, level, smooth without sharp projections which could puncture underslab vapour retarder.

.3 Ensure services are installed and inspected prior to installation of vapour retarder.

.4 Start of Work implies acceptance of conditions.

3.2 Installation – Above Grade Vapour Retarder

.1 Install vapour retarder on warm side of exterior wall, ceiling, and floor assemblies prior to installation of gypsum board and subfloor to form continuous retarder.

.2 Use sheets of largest practical size to minimize joints.

.3 Inspect for continuity. Repair punctures and tears with sealing tape before Work is concealed.

.4 Openings: Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

.5 Vapour Barrier Applied Directly to Framing:

.1 Apply continuous bead of sealant to substrate at perimeter of sheets.

.2 Press sheet into sealant.

.3 Install staples through sheet at sealant bead into wood substrate. Apply continuous strip of joint sealing tape along top edge of sheet to face of top plate.

.4 Apply continuous strip of joint sealing tape along top edge of sheet to face of runner track.

.6 Seams and Sealing:

.1 Lap sheets minimum 75 mm and seal seams with continuous bead of sealant and joint sealing tape.

.2 Bed vapour retarder in continuous bead of sealant along top and bottom edges abutting adjacent construction.

.3 Ensure no gaps exist in sealant bead.

.1 Smooth out folds and ripples occurring in vapour retarder over sealant.

.7 Electrical Boxes: Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:

.1 Install moulded box vapour retarder.

.2 Apply sealant to seal edges of moulded box flange to main vapour retarder and seal wiring penetrations through moulded box.

3.3 Installation – Underslab Vapour Retarder

.1 Install underslab vapour retarder in accordance with requirements of ASTM E1643.

.2 Use sheets of largest practical size to minimize joints.

.3 Seal vapour retarder to grade beams, foundation walls, and around penetrations using joint sealing tape.

.4 Inspect for continuity and repair in accordance with ASTM E1643 and as follows.

.1 Repair small punctures and tears with sealing tape before Work is concealed.

.2 Where damage to vapour retarder exceeds tape width, repair with additional layer of vapour retarder, minimum 300 mm overlap in all directions from edge of damage.

.1 Tape continuously around perimeter of patch.

3.4 Protection

.1 Protect installed products from damage during remainder of construction.

END OF SECTION

AIR-VAPOUR BARRIERS

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Self-adhering, vapour-retarding, modified bituminous sheet air barriers.

.2 Related Requirements:

.1 Section 07 52 00 – Modified Bituminous Membrane Roofing, for tie in to roof vapour retarder.

1.2 Administrative Requirements

.1 Pre-installation meetings: Schedule pre-installation meeting with Contractor, installer, manufacturer, the City, and necessary parties to review and discuss project conditions. Conduct pre-installation meeting minimum one week before starting air/vapour barrier Work and on-Site installations to:

.1 Verify project requirements.

.2 Verify substrate conditions.

.3 Co-ordinate products, installation methods and techniques.

.4 Sequence Work of related sections, including but not limited to structural-support framing, window system, and roofing.

.5 Co-ordinate with other building subtrades.

.2 Coordination: Sequence Work to permit installation of materials in conjunction with related materials and seals.

1.3 Action and Informational Submittals

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

.2 Product Data: For each type of product.

.3 Quality Assurance Submittals:

.1 Installer Qualifications.

.2 Statement of Compatibility: Provide letter(s), provided and signed by manufacturer of membrane air/vapour barrier material(s), that products used on the project are compatible with adjacent materials, and materials with which the membrane will be in contact or sealed.

.3 Manufacturer's Field Reports: submit manufacturer's written reports within three (3) days of review, verifying compliance of Work, as described in 3.7 - Field Quality Control.

1.4 Quality Assurance

.1 Installer Qualifications: Company specializing in performing Work of this section with minimum five (5) years' experience with installation of air/vapour barrier systems, trained and approved by manufacturer.

.2 Manufacturer's Services: as part of membrane manufacturer's services specified in 3.7 - Field Quality Control, schedule Site visits, to review Work, at stages listed.

.1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.

.2 Minimum one (1) time during progress of Work.

.3 Upon completion of Work, after cleaning is carried out.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management:

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

1.6 Site Conditions

.1 Environmental Limitations: Apply air/vapour barrier within the range of ambient and substrate temperatures recommended by air/vapour barrier manufacturer.

.1 Protect substrates from environmental conditions that affect air-barrier performance.

.2 Do not apply air/vapour barrier to a damp or wet substrate or during snow, rain, fog, or mist.

2. PRODUCTS

2.1 Performance Criteria

.1 General: Air/vapour barrier shall be capable of performing as a continuous vapour-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

.1 Incorporate continuous air/vapour barrier system, meeting or exceeding requirements of National Building Code, Part 5.

.2 Maximum air leakage through air barrier system within areas of exterior walls from roof to grade, and through joints between air barrier components of various assemblies: 0.02 L/(s·m^2) at 75 Pa pressure differential.

.3 Air/vapour barrier materials to provide continuous seal between components of building envelope and building penetrations, and connection to existing buildings.

2.2 Air/Vapour Barriers

.1 Membrane air/vapour barrier (AVB): Glass scrim reinforced SBS modified bitumen membrane or rubberized asphalt coated polyethylene or cross-laminated polyethylene bonded to modified asphalt, self-adhesive grade, 1.0 mm minimum thickness, 0.1 mm thickness polyethylene face.

.1 Acceptable Products: Bakor Blueskin SA, Carlisle CCW-705, IKO AquaBarrier AVB, Soprema Sopraseal Stick 1100T, W.R. Grace Perm-A-Barrier, W.R. Meadows Air-Shield.

2.3 Accessories

.1 Sheet Steel Transition Strip: 1.01 mm thick, zinc coated, cold rolled steel sheet, with Z275 designation coating to ASTM A653/A653M.

.2 Silicone Transition Strip: flexible silicone sheet air and vapour barrier with preformed corner pieces.

.1 Dimensions: 1.6 thick by 152 mm wide sheets.

.2 Hardness, to ASTM D2240, Type A Durometer: 43.

.3 Tensile strength to ASTM D412: 7.8 MPa.

.4 Ultimate elongation to D412: 550%.

.5 Adaptors: extruded aluminum profiles for connection to curtain wall framing, as required by silicone transition strip manufacturer's system.

.6 Corners: premoulded silicone sheets formed for corner conditions.

.7 Sealant: Manufacturer's recommended structural silicone. Confirm compatibility of silicone sheet with overlapping materials.

.8 Acceptable Products: Tremco Silicone Extruded Sheet; Dow Corning STS.

.9 Location: transitions between envelope components to maintain continuity of air/vapour barrier, except where using sheet steel transition strip.

.3 Sealant: butyl rubber base, single component, solvent release, non-skinning, as recommended by air/vapour barrier membrane manufacturer.

.4 Substrate Cleaner: Non-corrosive type recommended by membrane manufacturer compatible with adjacent materials.

.5 Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

.6 Termination Mastic: rubberized asphalt-based mastic.

.7 Surface Conditioner: Latex-based, water-dispersible liquid for substrate preparation, as recommended by membrane manufacturer.

.1 Flash point: no flash to boiling point.

.2 Solvent type: water.

.3 Application temperature: -4°C and above.

.8 Foam Seal: One- or two-component, foamed-in-place, polyurethane foam sealant, CFC-free, no added urea formaldehyde, non-shrinking after cure, CCMC listed.

.1 Maximum VOC content: 250 g/L (less water).

.2 Location: for use around perimeter of window and door frames, and other exterior wall penetrations.

3. EXECUTION

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Examination

.1 Verify that surfaces and conditions are ready to accept the Work of this section.

.2 Ensure surfaces are clean, dry, sound, smooth, continuous, and comply with air barrier manufacturer’s requirements.

.3 Report unsatisfactory conditions to the City in writing.

.4 Do not start Work until deficiencies have been corrected. Start of Work implies acceptance of conditions.

3.3 Surface Preparation

.1 Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air/vapour barrier application.

.2 Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

.3 Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

.4 Remove excess mortar from masonry ties, shelf angles, and other obstructions.

.5 Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks.

.6 Bridge and cover discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints as indicated.

.7 At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

.8 Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air/vapour barrier.

3.4 Installation – Membrane Air/Vapour Barrier

.1 When required by dirty or dusty site conditions; by surfaces having irregular or rough texture, or if difficultly is encountered in adhering membrane air/vapour barrier to substrate, apply surface conditioner by spray, brush, or roller at rate recommended by manufacturer, before membrane installation. Allow surface conditioner to dry completely before applying primer or membrane.

.2 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.

.3 Install membrane air/vapour barrier to dry surfaces at air and surface temperatures of -4°C and above in accordance with manufacturer's recommendations, to locations indicated.

.4 Precut pieces of membrane air/vapour barrier into easily-handled lengths. Minimize joints.

.5 Remove release paper, and position membrane carefully before placing length horizontally against substrate.

.6 Begin installation at base of wall placing bottom edge of membrane over sheet metal flashings, and shelf angles, as indicated.

.7 When properly positioned, place against surface by pressing firmly into place by means of hand roller ensuring full contact.

.8 Overlap adjacent pieces 50 mm, and roll seams.

.9 Apply subsequent sheets of membrane above, overlapping sheet below by 50 mm. Stagger vertical joints minimum 300 mm. Roll firmly into place.

.10 Slit membrane air/vapour barrier at penetration locations. Seal around penetrations with termination mastic. Extend out 50 mm onto protruding member.

.11 Continue membrane air/vapour barrier into openings in walls, including but not limited to doors and windows. Terminate at points that will prevent visibility from interior.

.12 Continue membrane air/vapour barrier over junctions, at changes in wall construction, and other construction. Reinforce corners with additional piece of membrane air/vapour barrier cut and formed to seal corners. Caulk to ensure complete seal. Position lap seal over firm bearing.

.13 Apply sealant within manufacturer's recommended application temperature range.

.14 At end of each Working Day seal top edge of membrane air/vapour barrier to substrate with termination mastic.

.15 Do not allow rubberized asphalt surface of membrane air/vapour barrier to come in contact with polysulfide sealants, creosote, uncured coal tar products or EPDM.

.16 Do not expose membrane air/vapour barrier to sunlight for more than thirty (30) days prior to enclosure.

.17 Inspect installation prior to enclosing. Repair punctures, damaged areas and inadequately lapped seams with a patch of membrane air/vapour barrier sized to extend 150 mm in all directions from perimeter of affected area.

.18 Ensure membrane air/vapour barrier is free of folds, bubbles and fish mouthing.

3.5 Installation – Sheet Steel Transition Strip

.1 Roof/Wall Transition: fasten sheet steel, bent to shape required, to roof and wall substrates. Length of legs indicated.

.2 Butt Joints:

.1 Clean and prime steel substrate to receive membrane air/vapour barrier in accordance with manufacturer's instructions.

.2 Apply 150 mm wide strip of membrane air/vapour barrier along joints.

.3 Roll firmly into place.

.3 Apply 150 by 150 mm patch of self-adhesive membrane air/vapour barrier over fasteners.

.4 Stagger joints in L-shape transition strip with joints in wall air/vapour barrier.

.5 Location: for use at roof/wall intersection for lapping roof vapour retarder, and wall air/vapour barrier membrane.

3.6 Installation – Silicone Transition Strip

.1 Apply silicone transition strip at joints between exterior wall components to maintain continuity of air/vapour seal in accordance with specified performance requirements.

.1 Capture and seal flexible seal at window framing, and storefront framing systems with purpose-made adaptor fastened and sealed to side of window and storefront framing.

.2 Seal transition strip to adjacent construction with not less than 75 mm lap using silicone.

.3 Install purpose made corner pieces of transition strip and seal to adjacent construction.

.4 Minimize joints in transition strip material.

.5 Lap end joints minimum 150 mm and seal.

.2 Inspect installation prior to enclosing. Repair punctures, damaged areas and inadequately lapped seams with a patch of transition strip sized to extend 150 mm in all directions from perimeter of affected area.

3.7 Field Quality Control

.1 Manufacturer's Field Services:

.1 Obtain written report from air/vapour barrier membrane manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as specified in 1.3 - Action and Informational Submittals.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule Site visits, to review Work, as specified in 1.4 - Quality Assurance.

3.8 Site Tests/Inspections

.1 Air/vapour barrier installation shall be inspected by an independent inspection agency appointed by the Contractor and approved by the City.

.2 Cost for inspection and testing shall be paid by cash allowance.

3.9 Protection of Work

.1 Do not permit adjacent work to damage Work of this section.

.2 Ensure finished Work is protected from climatic conditions.

END OF SECTION

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Conventional 2-ply modified bituminous roofing.

.2 Related Requirements:

.1 Section 06 10 00 - Rough Carpentry, for wood nailing strips, blocking, equipment curbs, plywood.

.2 Section 07 62 00 - Sheet Metal Flashings and Trim.

1.2 Action and Informational Submittals

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

.2 Product Data: Submit two (2) copies of most recent technical roofing components data sheets describing materials' physical properties.

.3 Shop Drawings:

.1 Indicate flashing, control joints, tapered insulation details, fastener patterns specific to wind uplift resistance requirements.

.2 Provide layout for tapered insulation.

.4 Quality Control and Assurance Submittals:

.1 Submit manufacturer's letters of assurance signed by officer of company:

.1 Submit design letter prior to installation.

.2 Submit installation letter following completion of roofing Work.

.2 Submit manufacturer's certificate certifying that products and system meet or exceed specified requirements.

1.3 Quality Assurance

.1 Manufacturer's representative (company providing written guarantee) shall:

.1 Attend Site at regular intervals including not less than one (1) visit at each of the following construction stages: pre-construction, 25%, 60%, and completion.

.2 Report in writing to Contractor, and the City conditions deemed detrimental to roofing system.

.3 Advise membrane manufacturer of such inspection.

.4 Ensure system placed in accordance with manufacturer's recommendations.

.5 Certify through manufacturer's letters of assurance that roofing system is designed in accordance with specified performance requirements and installed in compliance with manufacturer's instructions.

1.4 Delivery, Storage and Handling

.1 Delivery: Deliver materials to Site in original factory packaging, labelled with manufacturer's name and address.

.2 Storage and Handling Requirements:

.1 Store materials off ground, covered, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

.3 Store rolls of membrane in upright position, one pallet high.

.4 Remove only in quantities required for same day use.

.5 Place plywood runways over completed Work to enable movement of material and other traffic.

.6 Store sealants at +5°C minimum.

.7 Store insulation protected from daylight, weather and deleterious materials.

.8 Handle and store roofing materials in accordance with manufacturer's written directives, to prevent damage or loss of performance.

.3 Waste Management:

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

1.5 Ambient Conditions

.1 Install roofing within temperature range according to manufacturer's recommendations.

.1 Apply adhesives within their respective temperature application ranges.

.2 Provide hoarded and heated enclosures for roof work when conditions require.

.2 Install roofing on dry deck, free of snow and ice.

.3 Use only dry materials and apply only during weather that will not introduce moisture into roofing system.

1.6 Warranty

.1 Provide general warranty for one (1) year from date of Substantial Performance of Work.

.2 Manufacturer's guarantee: Provide manufacturer's written guarantee against failure of roofing system, leakage for period of fifteen (15) years from date of Substantial Completion of Work as agreed upon by the City, Contractor, roofing sub-contractor and membrane manufacturer.

.1 Guarantee: System and workmanship, covering but not limited to:

.1 Labour and material for repair, replacement of roofing components from structural deck up.

.2 Leakage, failure of roof system due to natural causes.

.3 Non-prorated.

2. PRODUCTS

2.1 Performance Requirements

.1 Perform roofing work in accordance with applicable standard in Canadian Roofing Contractors Association (CRCA) Roofing Specifications Manual and to manufacturer's instructions, except as specified otherwise.

.2 Roof covering (cap sheet): C classification in accordance with CAN/ULC-S107.

.3 Comply with applicable ULC, local authority having jurisdiction - Fire Hazard Classifications.

.4 Compatibility between components of roofing system is essential.

.1 Provide written statement, by roof system component manufacturer, that materials and components are compatible with each other and adjacent materials being tied into.

.5 Slope: Ensure finished roof surfaces slope to drains; minimum 2%.

.6 Wind Uplift Performance:

.1 Roof Wind Loads: Resist listed wind loads for parapet cladding:

.1 Corner (suction): - 2.4 kPa

.2 Edge (suction): - 1.4 kPa

.3 Corner & Edge (pressure): 1.1 kPa

.4 https://www.nrc-cnrc.gc.ca/eng/services/windrci/calculator/index.html?New+Calculation=New+Calculation

2.2 Deck Covering

.1 Glass Faced Gypsum Board: to ASTM C1177, pre-primed, mold resistant, moisture-resistant, non-combustible, water resistant gypsum core, glass mat facings, 12.7 mm thick, maximum practical lengths.

.1 Acceptable Product: GP Corporation DensDeck Prime, CGC SecuRock.

.2 Provide product with a minimum 25% recycled content, quantified as post-consumer + 1/2 pre-consumer recycled content as defined in Section 01 35 21 - Sustainability Requirements.

.2 Gypsum Fibre Roof Board: To ASTM C1278, mould resistant, moisture-resistant, non-combustible, homogenous composition panel.

.3 Plywood: to CSA O121 or CSA O151, Sheathing Grade, 12.7 mm thick, maximum practical lengths.

.1 Provide material with no added urea-formaldehyde or resins containing urea-formaldehyde.

.4 Gypsum Board Fasteners: #12 flat counter-sunk head, self-tapping, cadmium plated, length for minimum 19 mm penetration through steel deck.

.5 Flat Caps or Discs: flat metal 60 mm diameter, minimum 1 mm thick.

2.3 Vapour Retarder

.1 Vapour Retarder: Self-adhering rubberized asphalt sheet, comprised of SBS modified bitumen adhesive, factory-laminated to woven, high-density slip resistant polyethylene top surface, and release liner on bottom surface.

.1 Thickness: 0.8 mm.

.2 Moisture vapour permeance: 2.8 ng/Pa·s·m^2.

.3 Water absorption by weight: less than 0.1%.

.4 Acceptable Products: IKO MVP Modified Vapor Protector, Henry Bakor Vapor-Bloc SA, and Soprema Sopravap'r.

.2 Vapour Retarder Primer: Manufacturer's compatible primer composed of SBS synthetic rubber, adhesive enhancing resins, and volatile solvent used to prime substrates to enhance adhesion of membranes at temperatures above -10°C.

.3 Cold Weather Vapour Retarder: To CGSB 37.56M, polyester reinforced, Type 2, Class C, Grade 1, coated both sides with SBS modified asphalt, top and bottom surfaces: sanded/polyethylene.

.1 Thickness 3.0 mm.

.2 Water vapour permeance: Maximum 2.0 ng/Pa·s·m^2 to ASTM E96/E96M, Method B.

.3 Acceptable Products: Soprema Sopralene 180 SP 3.5, IKO Torchflex TP-180 FF-Base 3.0, Henry Bakor Modified Plus NP180 S/P 3.0.

.4 Accessory Transition Membrane: Provide manufacturer's standard self-adhered vapour retarder with thermofusible top surface.

.1 Location: Interface between vapour retarder and existing construction.

2.4 Insulation

.1 Primary Insulation: Glass fibre reinforced polyisocyanurate insulation to ASTM C 1289 Type 2 Class 1 Grade 2, 50 mm thick 1220 x 1220 mm board, closed cell, polyisocyanurate foam core bonded on each side to reinforced glass fibre facers, RSI 1.00 per 25 mm thickness.

.1 Acceptable products: IKO IKOTherm, Soprema Sopra-Iso, Hunter H-Shield.

.2 Cricket, Tapered Insulation: Expanded polystyrene (EPS) 1200 mm x 1200 mm boards, sloped in accordance with roof plan. Verify compatibility with adjacent roof system components. Review products limitations. Provide separation from petroleum based products.

.3 Protection Board: Glass faced gypsum board: to ASTM C1177, pre-primed, mold resistant, moisture-resistant, non-combustible, water resistant gypsum core, glass mat facings, 12.7 mm thick, maximum practical lengths.

.1 Acceptable Product: GP Corporation DensDeck Prime, CGC SecuRock.

.4 Insulation Adhesive: Compatible with insulation, vapour retarder, and acceptable to roofing system manufacturer:

.1 Acceptable Products: IKO Cold Gold or Millenium Adhesive, Henry Bakor Company Thermostik 880-33, and Soprema Duotack.

.5 Insulation Fasteners: Screws and plastic or steel stress plates, length to suit insulation thickness, penetrate deck minimum 25 mm.

2.5 Membrane

.1 Membrane Base Sheet (torch-on): To CGSB 37-GP-56M, Type 2, Class C, Grade 2, heavy duty modified bitumen roofing membrane, 180 g/m^2, non-woven, polyester reinforcing mat, coated both sides with SBS modified asphalt, thermofusible plastic film, 10 m long by 1 m wide, 3.0 mm thick.

.1 Acceptable Product: IKO Torchflex TP-180-FF-Base, Soprema Sopralene Flam 180, Henry Bakor Modified Plus NP180 P/P.

.2 Membrane Cap Sheet (torch-on): To CGSB 37-GP-56M, Type 1, Class A, Grade 2, heavy duty modified bitumen roofing membrane,250 g/m^2 non-woven, polyester reinforcing mat, coated both sides with SBS modified asphalt, bottom face covered with thermofusible plastic film, top face with coloured granules, 8 m long x 1 m wide, 4.0 mm thick.

.1 Colour: Selected by the City from manufacturer's standard range.

.2 Acceptable Product: Soprema Sopralene Flam 250 GR, IKO Torchflex TP-250-CAP, Henry Bakor Modified Plus NP250 g T4.

.3 Membrane Flashing:

.1 Base strip: self-adhesive with appropriate substrate primer.

.1 Acceptable Product: Soprema Sopralene Flam Stick, IKO Armourbond Flash, Bakor NP180 Tack Sheet.

.2 Cap strip: as specified for membrane cap sheet.

.4 Walkways: One (1) additional ply of cap sheet membrane.

.1 Colour: Contrasting from field membrane as selected by the City from manufacturer's standard range.

2.6 Miscellaneous

.1 Roofing Nails: to ASTM F1667, No. 10 corrosive resistant, ring thread roofing nails 9.5 mm heads.

.2 Bituminous Paint: to CAN/CGSB-1.108, Type 2.

.3 Sealing compound: to CAN/CGSB-37.29, rubber asphalt type.

.4 Metal Flashings: as specified to Section 07 62 00 - Sheet Metal Flashing and Trim.

.5 Roof Expansion Joint Membrane: flat copolymer sheet with internal polyester reinforcement allowing for 3 way movement.

.1 Acceptable Product: Situra Flamline20.

.2 Locations: For use at vapour retarder and membrane layers in roof expansion joints.

.6 Termination Bar: Stainless steel Type 304, 25 mm wide by 1.6 mm thick predrilled at 200 o.c. for surface fastening.

.7 Vent Stack Flashing: To CSA B272-93, vandal proof, 1.6 mm mill finish 1100-0T alloy aluminum, diameter to suit vents, aluminum hood and perforated collar, premoulded urethane insulation liner, bituminous painted deck flange.

.1 Acceptable Product: Thaler SJ-31 Vandal Proof Stack Jack Flashing.

3. EXECUTION

3.1 Workmanship

.1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual, and CRCA Roofing Specification Manual.

3.2 Examination of Roof Decks

.1 Prior to beginning of Work ensure:

.1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.

.2 Curbs have been built.

.3 Roof drains have been installed at proper elevations relative to finished roof surface.

.4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.

.2 Do not install roofing materials during rain or snowfall.

3.3 Deck Covering

.1 Mechanically fasten deck covering to steel deck with screws and plates to steel deck's upper rib surfaces, spaced as required by wind uplift requirements.

.2 Place with long axis of each sheet transverse to steel deck ribs, with end joints staggered and fully supported on ribs.

.3 Provide 400 mm wide continuous plywood deck covering under new curbs.

3.4 Vapour Retarder

.1 Expansion Joint Membrane:

.1 Roll out joint membrane and allow to relax.

.2 Clean deck covering in area of expansion joint.

.3 Place expansion joint membrane in coat of compatible membrane adhesive on deck covering.

.4 Secure each side of expansion joint membrane to plywood deck covering with termination bar fastened at 200 mm o.c.

.5 Seal vapour retarder to roof expansion joint membrane:

.1 Prime roof expansion joint membrane lapping surfaces and termination bars with compatible membrane primer.

.2 Seal vapour retarder to edge of gland on each side of joint, and roll surface to ensure full contact.

.2 Prime substrate as required by manufacturer.

.1 Ensure surfaces are free of residue that may hinder adherence.

.2 Allow primer to dry.

.3 Cover primed surfaces with vapour retarder within same work day.

3.5 Vapour Retarder

.1 Primer: Apply primer by roller or spray to all surfaces where vapour retarder is to be applied at rate of 4 to 6 m²/l and allow to dry.

.2 Vapour Retarder: Unroll and align vapour retarder centred at low point of roof or drain.

.1 Reroll and torch apply membrane applying even heat across width of roll.

.2 Apply sufficient heat to melt lower surface and provide flow of bitumen.

.3 Lap cap sheet 75 mm on sides and 150 mm on ends.

.3 Lap vapour retarder with wall air vapour barrier at roof/wall junction.

.4 Ensure continuity of vapour retarder at roof penetrations:

.1 Seal vapour retarder to penetrating element with continuous bead sealing compound around perimeter of vertical member penetrating vapour retarder.

3.6 Insulation

.1 Install tapered insulation in single layer to provide slopes, crickets indicated.

.1 Slope to drains: Minimum 2% positive slope of finished roof system.

.2 Adhere tapered insulation to substrate using acceptable compatible adhesive.

.3 Apply adhesive in 19 to 25 mm diameter beads.

.4 Apply first bead 76 mm from outer edges of insulation board.

.5 Apply additional parallel beads in accordance with roofing manufacturer's test data meeting wind uplift requirements.

.2 Install primary insulation in multiple layers using specified insulation adhesive in continuous beads.

.1 Apply adhesive in accordance with specified requirements for tapered insulation.

.2 Install multiple layers of insulation to achieve system insulation thicknesses indicated on Drawings.

.3 Work in insulation to ensure adhesion.

.3 Stagger joints from previous insulation layer, set boards in moderate contact each other, without gaps.

.4 Stagger end joints to provide smooth surface for installation of protection board.

.5 Neatly fit insulation to all penetrations, projections, and nailers.

.1 Fill joints and gaps with same insulation except use specified blanket insulation for gaps smaller than 25 mm wide.

.6 At end of each work period, apply membrane over exposed surfaces and edges of insulation and onto vapour retarder to render watertight.

.1 Remove seal on resumption of Work.

.7 Sump: Dish insulation at roof drains or provide purpose made insulation sump.

.1 Size: 1200 by 1200 mm.

.8 Cold Weather Installation: Install insulation generally as specified except provide mechanical fastening in place of adhesive:

.1 Attach mechanically with insulation fasteners in conformance with manufacturer's recommendations, and Factory Mutual standards 1-60 pertaining to number and placement of fasteners, namely Bulletin 1-28 for fastening to roof perimeters and corners.

3.7 Exposed Roofing Membrane Application

.1 Torch applied base sheet:

.1 Start roofing applications at the lowest point to ensure water runs over the laps of membrane.

.2 Apply base sheet beginning at low point of roof and align membrane along centre line of roof drain.

.1 Unroll to relax membrane.

.2 Re-roll and torch apply to substrate following manufacturer’s printed instructions.

.3 Take care not to burn membrane or its reinforcement or substrate.

.3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.

.4 Carry minimum 100 mm to vertical surfaces.

.5 Reinforce around projections and drains using additional ply of base sheet per manufacturer’s instructions.

.6 Application to be free of blisters, wrinkles and fishmouths.

.2 Torch applied cap sheet.

.1 Apply cap sheet beginning at low point of roof or centre of drain.

.1 Unroll to relax membrane.

.2 Re-roll and torch apply to base sheet following manufacturer's printed instructions.

.2 Carry up minimum 100 mm on vertical surfaces.

.3 Plan work so that both side and end laps of cap sheet are offset from those of base sheet.

.1 Minimum 300 mm for side and 450 mm for end laps.

.4 At all end or head laps of cap sheets, where T joint occurs, cut corner of membrane to be overlapped, on a 45 deg angle.

.5 Adhere strictly to manufacturer's instructions.

.6 Application to be free of blisters, wrinkles and fishmouths.

.3 Flashings:

.1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.

.2 Adhere base and torch cap sheet onto substrate in 1 m wide strips.

.3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal with sealing compound.

.4 Extend flashing base sheet over top of parapet caps, roof/wall transition curbs, and mechanical curbs.

.1 Lap 150 mm to wall substrate above roof/wall transition curbs and seal leading edge with sealing compound.

.2 Trowel sealing compound to provide smooth fillet termination.

.5 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.

.6 Provide 75 mm minimum side lap and seal.

.7 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.

.8 Extend top ply of membrane so it hangs down fascia and overlaps wood blocking. Securely nail to wood fascia at approximately 100mm staggered centres.

.9 Do Work in accordance with manufacturer's recommendations.

3.8 Flashing at Roof Edge

.1 Apply base sheet and cap sheet flashing membranes to primed surfaces and roof membrane and adhere torched in adhesion welding method.

.2 Stagger cap sheet membrane side laps minimum 300 mm from base sheet membrane side laps.

.3 Extend base sheet flashing membrane minimum 150 mm, cap sheet flashing minimum 250 mm onto roof surface.

.4 Extend top ply of membrane so it hangs down fascia, overlaps wood blocking minimum 75 mm.

.1 Securely nail to wood fascia at approximately 100 mm staggered centres.

3.9 Walkways

.1 Install walkway membrane in accordance with manufacturer's instructions around perimeter of roof access hatch, and locations indicated.

.2 Apply primer to cap sheet membrane and torch apply, ensuring selvage edge is removed.

3.10 Roof Penetrations

.1 Install roof drain pans, vent stack covers fall protection equipment flashings and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

3.11 Flashing Vents and Pitch Pockets

.1 Install polyethylene back-up rope between roof deck and vent stack, pitch pocket and caulk joint.

.2 Embed vent stack, pitch pocket flashing flange in 3 mm thickness of sealing compound on top of roofing membrane.

.3 Torch membrane flashings onto cap sheets, extend plies onto roof beyond outer edge of flange in accordance with manufacturer’s instructions.

.4 Fill retainers with plastic cement, sloping from inside to outside when flashed.

.5 Install metal flashing to vent stack pipe by turning metal over top edge of pipe, securing clamping ring.

.1 Co-operate with mechanical subtrades for building in lead, copper flashings for roof penetrations.

3.12 Flashing Curb Control Joints

.1 Form control joints to CRCA recommendations, as indicated.

.2 Embed blocking, insulation stops in 3mm sealing compound placed in continuous lengths, secured with nails, power-driven studs.

.3 Install membrane flashing.

.4 Extend top ply membrane flashing across top control joint curb, one from each side.

.5 Install metal flashing over joint formed to drain to both sides of joint.

3.13 Flashing Roof Drains

.1 Carry roofing membranes down into sump to edge of drain fitting.

.2 Embed flashing flange into 3 mm thickness of sealing compound on top of roofing membrane.

.3 Embed membrane flashings into heavy coatings of hot asphalt, sealant, extend plies onto roof beyond outer edge of flange in accordance with manufacturer direction.

3.14 Caulking to Roof Work

.1 Install caulking, sealing to roofing, sheet metal work required.

.2 Provide waterproof, weathertight roofing system.

3.15 Examination and Testing

.1 Independent roof specialist, examining and testing company as appointed by Contractor, approved by the City shall review all aspects of roofing Work, metal flashings, deck, blocking.

.1 The City will pay costs for independent roof specialist.

.2 Include costs for independent roof specialist.

.2 Roof specialist examiner has authority to initiate minor ‘no cost’ changes to details, to suit job Site conditions.

.3 Examine roofing in accordance with inspection procedures outlined by CRCA, including following:

.1 Preliminary roof deck examination to ensure deck surfaces are in proper condition to receiving roofing. Notify Contractor of deleterious conditions not corrected.

.2 Study of roofing specification, notification to this Section, Contract Administrator of any variances, discrepancies between good roofing practices, that specified.

.3 Examination of roofing materials on Site, notification to Contract Administrator of variances from specified materials.

.4 Examination of workmanship, installation of roofing materials, minimum one (1) trip per day during any roofing operation, made early each working day.

.4 Reports: Specialist examining and testing company shall submit:

.1 Daily, written reports.

.2 Duplicate final report, typewritten, within one (1) week final examination of any completed roof area, based on examination trips, results of examinations, in accordance with outlined procedures for roof examinations.

.5 Specialist examining and testing company shall take photographs of roofing Work in process, condition of roof surfaces, submit with written reports.

.1 Photographs indicating vantage point, date taken, description of peculiarities or comments.

.6 Repair or replace defaced or disfigured finishes caused by Work of this Section.

3.16 Protection

.1 Protect existing roofing from damage with plywood walkways.

.2 Cover walls and adjacent work where materials hoisted or used.

.3 Clean off drips and smears of bituminous material immediately.

.4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

.5 Prevent traffic over completed roofing except where required by Work above roof level. Where Work required above or adjacent to completed roof, protect completed roofing from damage:

.1 Provide 13 mm plywood walkways and materials storage surfaces over completed roofing.

.2 Limit traffic to plywood walkways.

.3 Comply with additional precautions deemed necessary by the City.

.4 Repair damage caused by non-compliance.

.6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

.7 Wherever openings or exposed roof decks cannot be sealed during work day, provide temporary membrane coverings satisfactory to the City.

3.17 Cleaning

.1 Remove bituminous markings from finished surfaces.

.2 In areas where finished surfaces are soiled caused by Work of this Section, consult manufacturer of surfaces for cleaning advice and complying with their instructions.

END OF SECTION

SHEET METAL FLASHING AND TRIM

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Formed roof drainage sheet metal fabrications.

.2 Formed low-slope roof sheet metal fabrications.

.3 Formed metal trim.

.2 Related Requirements:

.1 Section 07 52 00 - Modified Bituminous Membrane Roofing.

.2 Section 08 11 13, for metal flashing of Hollow Metal Doors and Frames.

.3 Section 08 33 23, for steel plate installation of Overhead Coiling Doors.

1.2 Action and Informational Submittals

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

.2 Product Data: Provide product data sheets for sheet metal, prefinished steel, and aluminum sheet materials. Include material descriptions, thickness, and finish characteristics demonstrating compliance with specifications.

.3 Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include following:

.1 Identification of material, thickness, weight, and finish for each item and location in Project.

.2 Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.

.3 Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.

.4 Details of termination points and assemblies, including fixed points.

.5 Details of edge conditions.

.6 Details of special conditions.

.7 Details of connections to adjoining work.

.8 Detail formed flashing and trim at scale of not less than 1:10.

.4 Samples:

.1 Sheet Metal Flashing: 300 mm long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.

.2 Trim, Metal Closures, Joint Intersections, and Miscellaneous Fabrications: 300 mm long and in required profile. Include fasteners and other exposed accessories.

.3 Accessories and Miscellaneous Materials: Full-size Sample.

.4 Anodized Aluminum Samples: Samples to show full range to be expected for each colour required.

1.3 Delivery, Storage and Handling

.1 Storage and Handling Requirements:

.1 Protect sheet metal during handling and storage to prevent staining, abrasion of finish coatings, bending, and denting.

.2 Protect surfaces of pre-coated metal to prevent scratching.

.3 Replace defective or damaged materials with new.

.2 Waste Management:

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

2. PRODUCTS

2.1 Sheet Metal Materials

.1 Zinc Coated Steel Sheet: minimum 0.61 mm base steel thickness, commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.

2.2 Prefinished Steel Sheet

.1 Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755M.

.1 Zinc-Coated (Galvanized) Steel Sheet: ASTM A653M, Z275 coating designation; structural quality.

.2 Surface: smooth.

.3 Exposed coil-coated finish: Silicone-modified polyester comprised of epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.005 mm for primer and 0.02 mm for topcoat.

.4 Colour: Selected by the City from manufacturer’s standard range.

.1 Allow three (3) colours in equal quantities except as indicated.

2.3 Aluminum Sheet

.1 Aluminum Sheet: ASTM B 209M, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

.1 Exposed Coil-Coated Finish: Three-coat fluoropolymer finish to AAMA 620, containing not less than 70% Kynar 500 or Hylar 5000 PVDF resin by weight in both colour coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

.2 Allow for one (1) colour selected by the City.

2.4 Accessories

.1 Isolation Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

.2 Sealing Compound: To CAN/CGSB-37.29, rubber asphalt type.

.3 Underlay for Metal Flashing: Dry sheathing to CAN/CGSB-51.32.

.4 Sealants: As specified in Section 07 92 00 - Joint Sealants.

.5 Cleats: Of same material, thickness, and temper as sheet metal flashing being secured, minimum 75 mm high.

.6 Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

.1 General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

.1 Exposed Fasteners: Heads matching colour of sheet metal using plastic caps or factory-applied coating.

.2 Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

.2 Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

.3 Fasteners for Metallic-Coated Steel Sheet, and Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

.7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.8 Touch-up Paint: as recommended by prefinished material manufacturer.

.1 Maximum VOC Content: 250 g/L, less water.

2.5 Fabrication

.1 General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated.

.1 Shop fabricate items shop to greatest extent possible.

.2 Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than specified for each application and metal.

.3 Obtain field measurements for accurate fit before shop fabrication.

.4 Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

.2 Conceal fasteners and expansion provisions where possible.

.1 Exposed fasteners are not allowed on faces exposed to view.

.3 Form pieces in 3000 mm maximum lengths.

.1 Make allowance for expansion at joints.

.2 Underflash at joints, with closed turned up ends.

.4 Hem exposed edges on underside 12 mm.

.5 Mitre and seal corners with sealant.

.6 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.7 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.6 Metal Flashings

.1 Flashing and Trim: Form exposed flashings, cap flashings, trim, copings and fascia to profiles indicated of prefinished steel sheet, minimum 0.76 mm thick, base metal thickness.

.2 Flashing and Trim: Form exposed flashing to profiles indicated of prefinished aluminum sheet, minimum 0.81 mm thick, base metal thickness.

.3 Flashing:

.1 Form concealed flashings to profiles indicated of minimum 0.61 mm thick galvanized sheet steel.

.2 Through-wall flashing: Fabricate continuous sections from minimum 0.61 mm thick galvanized sheet steel for under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 150 mm beyond each side of wall

openings. Form with 50-mm- high, end dams where flashing is discontinuous for positive drainage out of wall cavities.

2.7 Scuppers

.1 Fabricate 4-sided through-wall scuppers of dimensions required with closure flange trim to exterior, 100 mm wide wall flanges to interior, and base extending 100 mm beyond tapered strip into field of roof.

.1 Material: 0.76 mm thick prefinished steel sheet at locations exposed to view 0.61 mm thick galvanized sheet steel at locations not visible to public.

.2 Form scuppers in accordance with applicable SMACNA Architectural Sheet Metal Manual, and install in accordance with CRCA specifications and details, to size and profile indicated.

2.8 Reglets

.1 Form reglets from 0.61 mm thick galvanized sheet steel, to be built-in masonry work for base flashings, as detailed.

3. EXECUTION

3.1 Installation

.1 Install sheet metal work in accordance with SMACNA Architectural Sheet Metal Manual, and as detailed.

.1 Install sheet metal flashing and trim true to line and levels indicated.

.2 Provide uniform, neat seams with minimum exposure of sealant, and welds.

.3 Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

.4 Install sheet metal flashing and trim to fit substrates and to result in watertight performance.

.5 Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

.6 Torch cutting of sheet metal flashing and trim is not permitted.

.7 Do not use graphite pencils to mark metal surfaces.

.2 Use concealed fastenings except where approved before installation.

.3 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.

.1 Allow for expansion using flat Double S joint per SMACNA Architectural Sheet Metal Manual.

.4 Lock end joints and caulk with sealant.

.5 Metal protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA Architectural Sheet Metal Manual.

.1 Coat back side of uncoated aluminum sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

.2 Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install course of polypropylene sheet.

.1 Secure in place and lap joints 100 mm.

.6 Insert metal flashing into reglets, under cap flashing to form weathertight junction.

.7 Caulk flashing at cap flashing with sealant.

.8 Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

.1 Space movement joints at a maximum of 3 m with no joints allowed within 1 m of corner or intersection.

.2 Vertical Surfaces: 76 mm Lap per SMACNA Architectural Sheet Metal Manual.

.3 Horizontal Surfaces: 20 mm Hook Seam per SMACNA Architectural Sheet Metal Manual.

.1 Fill with sealant concealed within joints.

.9 Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA Architectural Sheet Metal Manual, and as indicated.

.1 Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 75 mm centres.

.10 Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA Architectural Sheet Metal Manual, and as indicated.

.1 Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 400 mm centres.

.2 Anchor interior leg of coping with washers and screw fasteners through slotted holes at 600 mm centres.

.11 Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum 100 mm over base flashing.

.1 Install stainless-steel draw band and tighten.

3.2 Scuppers

.1 Parapet Scuppers: Install scuppers where indicated through parapet in accordance with applicable SMACNA Architectural Sheet Metal Manual details.

.1 Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over tapered edge strips, and under roofing membrane.

.2 Seal joints watertight.

.3 Waterproof scupper opening.

.1 Set flanges in bed of compatible sealant.

.2 Seal membrane flashing base sheet into scupper box and terminate at sheet metal gravel stop.

.4 Where scupper terminates at exterior wall, anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.

3.3 Cleaning and Protection

.1 Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

.2 Clean off excess sealants.

.3 Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

.4 On completion of installation, remove unused materials and clean finished surfaces.

.5 Maintain Site in a clean condition during construction.

.6 Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touch-up or similar minor repair procedures.

END OF SECTION

FIRESTOPPING

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Fire stopping by single firestopping subtrade.

1.2 Definitions

.1 Fire Stop: a system consisting of a material, component and means of support used to fill gaps between fire separations or between fire separations and other assemblies, or used around items that wholly or partially penetrate a fire separation.

.2 Fire Separation: a construction assembly that acts as a barrier against the spread of fire.

.3 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.

.4 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.

.5 Tightly Fitted: penetrating items that are cast in place in buildings of non-combustible construction or have "0" annular space in buildings of combustible construction.

.1 Words "tightly fitted" should ensure that integrity of fire separation is maintained.

1.3 Action and Informational Submittals

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

.2 Product Data: For each type of product indicated. Indicate:

.1 Technical data on out-gassing; off-gassing and age testing.

.2 Curing time.

.3 Chemical compatibility to other construction materials.

.3 Submit system design listings, including illustrations from qualified testing and inspection agency applicable to each firestop configuration. Indicate proposed material, reinforcement, anchorage, fastenings, and method of installation. Construction details should accurately reflect actual job conditions.

.4 Certificates.

1.4 Closeout Submittals

.1 Incorporate the following information in the Operation and Maintenance Manual:

.1 Material Safety Data Sheets (MSDS).

.2 Product literature of each product used on this project.

.3 For each fire stop system indicate: Room number/name, location within room, rating, engineering judgements, product description, maintenance requirements, and life expectancy of each product installed on this project. List date of installation for each product and the month/year of the expected expiration of each product.

.4 Progress photographs.

.5 Warranty:

.1 Manufacturer's warranty.

.2 Fire Stop Sub-Trade warranty.

.6 Provide a mark-up as-built to the City two (2) weeks prior to Substantial Completion of the Work.

1.5 Quality Assurance

.1 Fire-Test-Response Characteristics: Provide firestopping System Design Listing by testing and inspection agency in accordance with appropriate ASTM standards. Qualified testing and inspection agencies include UL, ULC, cUL, Intertek Testing Services, or another agency performing testing and follow-up inspection services for firestop materials that is acceptable to authority having jurisdiction.

.2 Single Source Responsibility: Obtain firestop systems for each kind of penetration and construction conditions indicated from a single primary firestop systems manufacturer.

.1 Do not intermix materials of different manufacture than allowed by tested and listed system in the same firestop system or opening.

.2 Use tested and listed firestop systems. If such systems are not possible, install an Engineering Judgement (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA).

.3 Certification: by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are non-toxic to building occupants.

1.6 Delivery, Storage, and Handling

.1 Deliver firestopping products to Project Site in original, unopened containers, or packages with intact and legible manufacturer's labels identifying product and manufacturer.

.2 Store and handle firestopping materials in accordance with manufacturer's written instructions.

.3 Waste Management:

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

1.7 Environmental Requirements

.1 Environmental Conditions: Install firestopping in accordance with manufacturers written instructions.

.2 Ventilation: Ventilate in accordance with firestopping manufacturers' instructions or Material Safety Data Sheet (MSDS).

.3 Do not use materials that contain flammable solvents.

.4 Water-based products are unacceptable in wet areas or areas that may be subject to occasional flooding.

2. PRODUCTS

2.1 Acceptable Manufacturers

.1 A/D Fire Protection Systems.

.2 Hilti Fire Stop Systems.

.3 3M Fire Protection Products.

.4 Tremco Fire Stop Systems.

.5 RectorSeal.

.6 Specified Technologies Inc. (STI).

2.2 Performance Criteria

.1 Penetrations: firestopping systems produced to resist spread of fire and passage of smoke and other gases according to requirements indicated, including but not limited to:

.1 Firestop penetrations passing through fire resistance rated wall and floor assemblies, and other locations as indicated.

.2 Complete penetration firestopping systems tested and approved by third party testing agency.

.2 Obtain an Engineering Judgement (EJ) or Equivalent Fire Resistance Rated Assembly (EFFRA) submittal from firestop manufacturer where there is no specific third party tested and classified firestop system available for a particular firestop configuration.

2.3 Materials

.1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

.1 Asbestos-free materials and systems capable of maintaining an effective barrier against the passage of flame, smoke, water and toxic gases in compliance with requirements of

CAN/ULC-S115 or ASTM E814, and not to exceed opening sizes for which they are intended, in accordance with ULC or cUL Design Numbers or other Design System Listings acceptable to local Authority Having Jurisdiction.

.2 Firestopping materials/systems shall be flexible to allow for movement of building structure (refer to architectural and structural) and penetrating item(s) without affecting the adhesion or integrity of the system.

.3 Maximum VOC Content: 350g/L (less water).

.2 Firestop products may include, but not be limited to:

.1 Sealants, sprays, mortars, fire straps, and breaks.

.2 Fire barrier mouldable putties, with or without backing.

.3 Fire barrier self-locking pillows containing intumescent composition.

.4 Fire barrier composite sheets used to cover large or blank openings, made up of steel sheet on one side with intumescent composition inside and steel wire mesh/foil on back side.

.5 Firestop devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

.3 Firestopping and smoke seal systems: in accordance with CAN/ULC-S115.

.4 Service penetration assemblies: certified by ULC in accordance with CAN/ULC-S115 and listed in ULC Guide No.40 U19.

.5 Service penetration firestop components: certified by ULC in accordance with CAN/ULC-S115 and listed in ULC Guide No.40 U19.13 and ULC Guide No.40 U19.15 under the Label Service of ULC.

.6 Fire-resistance rating of installed firestopping assembly in accordance with National Building Code with Manitoba amendments.

.7 Firestopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

.8 Firestopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical and electrical items requiring sound and vibration control: firestop collars or wrap devices; elastomeric seal.

.9 Firestopping at large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways: blocks and boards.

.10 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.

.11 Sealants for vertical joints: non-sagging, non-shrinking, asbestos-free.

.1 Maximum VOC Content: 250 g/L, less water.

.12 Fire-Rated Acoustical Sealant: rated for use in fire-resistance rated partitions requiring sound transmission control.

.13 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.1 Maximum VOC Content: 200 g/L, less water.

.14 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.15 Labels: self-adhering-type metal labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

.1 The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Damage."

.2 Plate Penetration Number.

.3 Floor Level.

.4 Room Number.

.5 Product Name.

.6 ULC or cUL System Design No.

.7 Fire Rating Required: _____ hour(s).

.8 Contractor's name, address, and phone number.

.9 Date of installation.

.10 Manufacturer's name.

.11 Installer's name.

.12 Re-penetrated by:

Company	**Installer**	**Date**

3. EXECUTION

3.1 Acceptable Installers

.1 National Firestop Ltd., 405 Gunn Road, PO Box 16 Grp 514 RR5, Winnipeg, Manitoba R2C 2Z2, Phone: (204) 777-0100.

.2 Total Fire Stop Systems Limited, Box 464, Stony Mountain, Manitoba R0C 3A0, Phone: (204) 344-5696.

.3 Western Construction Services Ltd., 300 Dawson Road N., Winnipeg, Manitoba R2J 0S7, Phone: (204) 956-9475.

.4 Secure Firestop, B-580 Dobbie Street, Winnipeg, Manitoba, Phone: (204) 667-8859.

3.2 Examination

.1 Examine substrates and conditions with installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Notify the City of unsatisfactory conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

.2 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.

.3 Verify that penetrating elements and supporting devices have been properly installed, and that temporary lines, and markings, have been removed.

.4 Verify that field dimensions are as indicated and as recommended by manufacturer.

.5 Ensure no additional items have been installed through openings that do not appear on approved Design Listing.

.6 Ensure areas that are to be firestopped are accessible for proper application and conditions are suitable for installation and inspection of firestop system.

.7 Report in writing to the City any defective surfaces or conditions affecting the firestop system installation, immediately and prior to commencing any installations.

.8 Proceed only when defected surfaces or conditions have been corrected.

3.3 Preparation

.1 Prepare surfaces in contact with firestopping materials and smoke seals to manufacturer's instructions.

.2 Maintain insulation around pipes and ducts penetrating fire separation without interruption to air/vapour barrier.

.3 Mask where necessary to avoid spillage and over coating onto adjoining surfaces.

.4 Remove masking as soon as possible, without disturbing seal between firestopping and substrates. Remove stains on adjacent surfaces.

.5 Ensure temperature within the areas of installation meets or exceeds the minimum temperature range for the products that will be installed in those areas, as based on the manufacturer's recommendations for a minimum two (2) days prior and three (3) days after installation.

3.4 Installation

.1 General:

.1 Install fire-stop material to obtain fire-resistance rating not less than the fire resistance rating of surrounding floor and wall assembly.

.2 Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions.

.3 Seal holes or voids made by through penetrations, poke-through termination devices, and un-penetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.4 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.5 Tool or trowel exposed surfaces to neat finish.

.2 Penetration Firestops:

.1 Coordinate with other trades to ensure pipes, conduit, cable, and other items, which penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.

.2 Schedule Work to ensure partitions and other construction that conceals penetrations are not erected prior to installation of firestop and smoke seals.

.3 Install fill materials for through-penetrations firestop systems to produce following results:

.1 Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

.2 Install materials so they contact and adhere to substrates formed by opening and penetrating items.

.3 For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces.

.3 Firestop Joint Systems:

.1 Install joint fillers to provide support of firestop materials during application. Install joint filler at position required to produce cross-sectional shapes and depths of installed

firestop material relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.

.2 Install systems by proved techniques that result in firestop materials:

.1 Directly contacting and wetting joint substrates.

.2 Filling recesses provided for each joint configuration.

.3 Providing uniform, cross-sectional shapes and depths relative to joint width that optimize movement capability.

.3 Tool non-sag firestop materials immediately after application and prior to skinning. Form smooth, uniform beads of configuration indicated or required to:

.1 Produce fire-resistance rating.

.2 Eliminate air pockets.

.3 Ensure contact and adhesion with sides of joint.

.4 Perimeter Fire Barrier Systems:

.1 Install metal framing, mineral wool insulation, mechanical attachments, safing materials, and firestop materials as applicable within system design.

3.5 Special Requirements

.1 Install fire stopping within existing buildings and in fire separations between existing buildings and new construction immediately after an opening requiring fire stopping has been made in a fire separation.

3.6 Labeling

.1 Install labels adjacent to through wall/floor service penetrations and joints that are fire stopped, and at joint penetrations. Provide one (1) assembly identification label per penetration opening and one (1) assembly identification plate at every 6000 mm along bottom and top of wall joints, and wall to wall joints.

.2 Fill out and install labels prior to Substantial Completion.

.3 Clean substrate prior to applying label.

.4 Securely apply label to substrate.

.5 Install label 50 mm away from penetration or joint.

3.7 Cleaning

.1 Remove excess materials and debris and clean adjacent surfaces immediately after application. Use methods and cleaning materials approved by manufactures of fire stopping products and assemblies in which openings and joints occur.

.2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.8 Protection

.1 Protect fire stopping during and after curing period from contact with contaminating substances.

END OF SECTION

JOINT SEALANTS

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Sealants.

.2 Related Requirements:

.1 Section 07 84 00 - Firestopping, for sealing joints in fire-resistance-rated construction.

1.2 Action and Informational Submittals

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

.2 Product Data: for products indicated.

.3 Samples:

.1 Submit duplicate colour samples of each type of material and colour.

.2 Where custom colours are requested, submit colour samples of actual product for review by the City.

1.3 Delivery, Storage, and Handling

.1 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

.2 Waste Management:

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

1.4 Project Conditions

.1 Do not proceed with installation of joint sealants under following conditions:

.1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 5°C.

.2 When joint substrates are wet.

.3 Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

.4 Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.5 Ambient Conditions

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.

.2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.3 Ventilate area of Work by use of approved portable supply and exhaust fans.

.1 For Work within existing buildings, arrange with the City for ventilation system to be operated on maximum outdoor air and exhaust during installation of caulking and sealants.

2. PRODUCTS

2.1 General

.1 Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

.2 Do not use sealants that emit strong odours, contain toxic chemicals or are not certified as mould resistant in air handling units.

.3 When low-emitting sealants are not possible, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.

.4 Where sealants are qualified with primers use only those primers.

.5 Maximum volatile organic compound (VOC):

.1 Architectural Sealants: Maximum 250 g/L (less water).

.2 Modified bituminous sealant primers: Maximum 500 g/L (less water).

.3 Architectural sealant primers for non-porous materials: Maximum 250 g/L (less water).

.4 Architectural sealant primers for porous materials: Maximum 775 g/L (less water).

.5 Structural glazing adhesives/sealant: Maximum 100 g/L (less water).

2.2 Materials

.1 Neutral cure, one part, low modulus silicone, movement range to ±50%, for exterior and interior use on concrete, masonry, stone, metals, glass, porcelain, control joints, expansion joints; to ASTM C920, Type S, Grade NS, Class 50, colour selected by the City.

.1 Acceptable products: GE SCS2000 Silpruf, Dow Corning 790, Tremco Spectrum 2.

.2 One component, polyurethane, for interior, exterior use in aluminum, window frame joints, heel beads, toe beads, and air seals; to ASTM C920, Type S, Grade NS, Class 25, colour selected by the City.

.1 Acceptable products: Tremco Vulkem 116, Sika Canada Sikaflex 1-a, Tremco Dymonic.

.3 Multi-component, polyurethane, for finished, interior, exterior areas in control joints, concrete, precast concrete, tile, floors, and walks to ASTM C920, Type S, Grade NS, Class 25, colour selected by the City.

.1 Acceptable products: Sika Canada Sikaflex 2c, Tremco Dymeric 240.

.4 Mildew-resistant, to ASTM C920, Type S, Grade NS, Class 25, one part, high modulus silicone, movement range ±25%, for interior use in wet areas around mop sink bases, and lavatories, toilets, and other plumbing fixtures. Colour selected by the City.

.1 Acceptable products: Dow Corning 786, Tremco Tremsil 200, GE Sanitary SCS1700, Franklin International Titebond Kitchen and Bath Sealant.

.5 Mildew-resistant, paintable silicone, to ASTM C920, Type S, Grade NS, Class 25, one part, high modulus silicone, movement range ±25%, for interior use around countertops, other counter surfaces adjacent to painted surfaces.

.1 Basis of Design: GE Groov Kitchen/Bath/Plumbing.

.6 Acrylics One Part: general purpose, one part, paintable translucent acrylic, movement range ±10%, for interior use in dry areas around windows, door frames, interior caulking to gypsum board, masonry, and metals; to ASTM C834.

.1 Acceptable products: Tremco Mono 555, Franklin International Titebond Painters Plus Caulk, GE RCS20 Siliconized Acrylic Sealant.

.7 Acoustical Sealant, for use at perimeter joints in sound rated gypsum board partitions, and masonry partitions:

.1 For exposed and joints: non-sag, paintable, non-staining latex sealant complying with ASTM C834.

.1 Acceptable products: GE RCS20 Siliconized Acrylic Sealant.

.2 For concealed joints: to CAN/CGSB-19.21, non-drying, non-hardening, non-skinning, non-staining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

.1 Acceptable products: Tremco Acoustical Sealant.

.8 Joint Cleaner: Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.

.9 Primer: as recommended by manufacturer.

.1 Maximum VOC Content: 200g/L, less water.

.10 Back-up Materials:

.1 Backer rod: polyethylene, closed cell foam backer rod, compatible with sealant, recommended by manufacturer, diameter oversize 30 to 50% to suit joint.

.1 Acceptable products: Dow Chemical Ethafoam, Tremco Sof Rod.

.2 Bond breaker tape: polyethylene, pressure sensitive bond breaker tape which will not bond to sealant.

.11 Preformed Foam Joint Sealant: Manufacturer's standard preformed, pre-compressed, open-cell foam sealant manufactured from urethane foam with minimum density of 160 kg/m^3 and impregnated with non-drying, water-repellent agent. Factory produce in pre-compressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.

.1 Acceptable products: Emseal Joint Systems Ltd. Backerseal.

3. EXECUTION

3.1 Examination

.1 Examine joints indicated to receive joint sealants, with installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

.1 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.2 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.3 Ensure joint surfaces are dry and frost free.

.4 Prepare surfaces in accordance with manufacturer's directions.

.5 Test materials being sealed, caulked for staining, adhesion.

.6 Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 Priming

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 Backup Material

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 Mixing

.1 For multi-component sealants, mix materials in strict accordance with sealant manufacturer's instructions.

3.6 Application

.1 Sealant:

.1 Apply sealant in accordance with manufacturer's written instructions.

.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

.3 Apply sealant in continuous beads.

.4 Apply sealant using gun with proper size nozzle.

.5 Use sufficient pressure to fill voids and joints solid.

.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.7 Tool exposed surfaces before skinning begins to give slightly concave shape.

.8 Remove excess compound promptly as work progresses and upon completion.

.9 Apply non-paintable silicone sealants after wall surfaces have been painted.

.2 Curing:

.1 Cure sealants in accordance with sealant manufacturer's instructions.

.2 Do not cover up sealants until proper curing has taken place.

.3 Cleanup:

.1 Clean adjacent surfaces immediately and leave Work neat and clean.

.2 Remove excess and droppings, using recommended cleaners as work progresses.

.3 Remove masking tape after initial set of sealant.

END OF SECTION

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Fire-rated hollow metal doors.

.2 Non-rated hollow metal doors.

.3 Fire-rated hollow metal frames.

.4 Non-rated hollow metal frames.

.2 Related Requirements:

.1 Section 04 22 00 - Concrete Unit Masonry, for embedding anchors for hollow metal work into masonry construction.

.2 Section 08 06 71 - Door Hardware Schedule.

.3 Section 08 71 00 - Door Hardware.

.4 Division 26, Electrical: for provision of electrical, conduit, wire runs and connections for electronic hardware.

.5 Division 28, Electronic Safety and Security: for coordination of electronic security systems with Work of this Section.

1.2 Administrative Requirements

.1 Coordination: Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project Site in time for installation.

1.3 Action and Informational Submittals

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

.2 Product Data: for each type of door specified. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.

.3 Shop Drawings:

.1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, arrangement of hardware and fire rating and finishes.

.2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing fire rating finishes.

.3 Include schedule identifying each unit, with door marks and numbers relating to numbering on Drawings and door schedule.

1.4 Quality Assurance

.1 Fabricate and install steel doors and frames in accordance with Canadian Steel Door Manufacturers' Association, "Canadian Manufacturing Specifications for Steel Doors and Frames".

1.5 Delivery, Storage and Handling

.1 Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-Site storage. Do not use non-vented plastic.

.2 Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

.3 Store hollow metal work under cover at Project Site. Place in stacks of five (5) units maximum in a vertical position with heads up, spaced by blocking, on minimum 100 mm high wood blocking. Do not store in a manner that traps excess humidity.

.4 Waste Management:

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

2. PRODUCTS

2.1 Design Requirements

.1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to +35°C.

.2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.

.3 Steel Fire Rated Doors and Frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC-S104 for ratings specified or indicated.

.4 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN/ULC-S104 and listed by nationally recognized agency having factory inspection services.

2.2 Materials

.1 Hot Dipped Galvanized Steel Sheet: tension leveled steel to ASTM A924, galvanized to ASTM A653M, commercial steel (CS) Type B, coating designation ZF120, minimum base steel thickness in accordance with CSDMA Table 1 – Minimum Steel Gauges for Component Parts.

.2 Hardware Reinforcement: cold or hot rolled steel, galvanneal coated. Minimum base steel thickness in accordance with CSDMA Recommended Specifications for Commercial Steel Door and Frame Products, Table 1 – Minimum Steel Gauges for Component Parts, unless indicated otherwise.

.1 Hinge reinforcement: minimum 5 mm thick.

.2 Surface mounted hardware reinforcement: minimum 2.5 mm thick.

.3 Flush bolt reinforcement: minimum 5 mm thick.

.3 Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized. Minimum base steel thickness in accordance with CSDMA Recommended Specifications for Commercial Steel Door and Frame Products, Table 1 – Minimum Steel Gauges for Component Parts.

.1 For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

.4 Touch-up Primer: rust-inhibitive. Maximum VOC limit 50 g/L.

.5 Accessories:

.1 Door Silencers: Single stud rubber/neoprene type.

.2 Glazing Stops: Fabricate glazing stops as formed channel, minimum 1.2 mm thick galvanized sheet steel with ZF120 finish, 16 mm height, accurately fitted, butted at corners, suitable for screw fastening to frame sections with counter-sunk oval head sheet metal screws. Design exterior glazing stops to be tamperproof.

.3 Metallic Paste Filler: To manufacturer's standard.

.4 Fire Labels: Metal riveted.

2.3 Fabrication – Welded Doors

.1 Fabricate doors in accordance with CSDMA specifications.

.2 Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core:

.1 Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

.2 Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value of not less than 2.166 K x sq. m/W when tested according to ASTM C 1363.

.1 Locations: Exterior doors and interior doors where indicated.

.3 Vertical Steel Stiffener.

.4 Temperature Rise Rated (TRR): composition to limit temperature rise on unexposed side of door to 120°C at thirty (30) minutes. Core to be tested as part of a complete door assembly, in accordance with CAN/ULC-S104 and listed by nationally recognized testing agency having factory inspection service.

.3 Doors: Laminated Core Construction:

.1 Exterior Doors: Form face sheets from 1.2 mm sheet steel with polyurethane insulated vertically stiffened core laminated under pressure to face sheets.

.2 Interior Doors: Form face sheets from 1.2 mm sheet steel with honeycomb temperature rise rated vertically stiffened core laminated under pressure to face sheets.

.3 Vertical Steel Stiffener:

.1 Reinforce doors with vertical stiffeners, securely laminated to face sheets at 150 mm on centre maximum.

.2 Fill voids between stiffeners of exterior doors with polyurethane insulation.

.3 Fill voids between stiffeners of interior doors with temperature rise rated core.

.4 Doors: Welded Core Construction:

.1 Exterior doors: Form face sheets from 1.2 mm sheet steel with vertically stiffened core.

.2 Interior doors: Form face sheets from 1.2 mm sheet steel with vertically stiffened core.

.3 Reinforce doors with vertical steel stiffeners, securely welded to each face sheet at 150 mm on centre maximum.

.1 Fill voids between stiffeners of exterior doors with polyurethane insulation.

.2 Fill voids between stiffeners of interior doors with temperature rise rated core.

.5 Door Type: swing type, flush, with provision for glass and louvre openings as indicated.

.6 Edges: Fabricate doors with longitudinal edges continuously welded, filled and sanded with no visible edge seams. Bevel vertical edge on latch side of single-acting doors 3 mm in 50 mm.

.7 Blank, reinforce, drill doors and tap for mortised, templated hardware, and electronic hardware.

.1 For electronic door hardware and controls provide minimum 13 mm conduit within door as required and cut-outs for hardware items.

.8 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.

.9 Reinforce doors where required, for surface mounted hardware, and around perimeter of cut-outs for glazing and louvres. Provide full height hinge reinforcement where continuous hinges are scheduled.

.10 Top and Bottom Edges:

.1 Exterior doors: Flush steel top caps, and flush spot welded channel at bottom, same material as door face sheets.

.2 Interior doors: Inverted, spot welded channels at top and bottom, same material as door face sheets.

.11 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

.12 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/ULC-S104 and 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.

.13 Provide astragals for pairs of doors in accordance with ULC requirements where indicated in Door Hardware Schedule.

.14 Where pairs of doors are scheduled to receive concealed top and bottom rod exit devices, provide doors that are ULC-approved without the use of an astragal and with only 6 mm clearance from finished floor to bottom of door.

2.4 Fabrication – Welded Frames

.1 Welding: In accordance with CSA W59.

.2 Fabricate frames in accordance with CSDMA specifications.

.3 Fabricate frames to profiles and maximum face sizes as indicated. Provide drywall frame profile with drywall returns for frames installed in gypsum board partitions.

.4 Exterior Frames: 1.6 mm welded thermally-broken construction.

.1 Fabricate thermally broken frames separating exterior parts from interior parts with continuous interlocking thermal break.

.5 Interior Frames: 1.6 mm welded construction.

.6 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

.7 Perimeter Corner Joints: as defined in Appendix 2 of CSDMA, “Recommended Specifications for Commercial Steel Door and Frame Products”, except as specified otherwise:

.1 Profile welded, punch-mitered: continuously welded on inside of frame along profile faces, rabbets, returns and soffit intersections. Fill exposed faces and grind smooth to uniform seamless surface.

.2 Tack welded: not permitted.

.8 Joints at mullions, sills and centre rails:

.1 Accurately coped, butted and tightly fitted.

.2 At intersecting flush profile faces: securely welded on inside of frame, filled and ground to smooth, uniform, seamless surface.

.3 At intersecting recessed profile faces: securely welded on inside of frame to concealed reinforcements, with exposed hairline face seams.

.4 At other intersecting profile elements: exposed hairline face seams.

.9 Blank, reinforce, drill and tap frames for mortised, templated hardware , and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

.1 Provide full height hinge reinforcement where continuous hinges are scheduled.

.2 For electronic door hardware and controls provide hinge junction box and outlet junction box at hardware mounting locations as required and cut-outs for hardware items.

.10 Protect strike and hinge reinforcements, and mortised cutouts with steel guard boxes.

.11 Provide backbend return on frame throat for gypsum board partitions.

.12 Prepare non-fire rated frames for door silencers; three for single door, two at head for double door.

.13 Conceal fastenings except where exposed fastenings are indicated.

.14 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

.15 Shop-install polyurethane insulation in closed sections of exterior frame components.

.16 Securely attach floor anchors to inside of each jamb profile.

.17 Weld in two temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.5 Frame Anchorage

.1 Provide appropriate anchorage to floor and wall construction.

.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

.3 Masonry partitions: Where frames are installed in prepared openings, countersink frame at screw anchor location. Provide adjustable frame anchors on each jamb as follows:

.1 Frames up to 2250 mm height: three L-strap anchors.

.2 Frames 2250 to 2400 mm in height: four L-strap anchors.

.3 Frames over 2400 mm in height: four L-strap anchors, plus one additional anchor for each 600 mm or fraction thereof over 2400 mm.

.4 Stud partitions: Provide steel anchors of suitable design, on each jamb as follows:

.1 Frames up to 2250 mm in height: three anchors.

.2 Frames 2250 to 2400 mm in height: four anchors.

.3 Frames over 2400 mm in height: five anchors, plus one additional anchor for each 600 mm or fraction thereof over 2400 mm.

.5 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

3. EXECUTION

3.1 Installation General

.1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.

.2 Install doors and frames to CSDMA Installation Guide.

3.2 Frame Installation

.1 Set frames plumb, square, level and at correct elevation.

.1 Maximum diagonal distortion: 1.6 mm.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 For large frames assembled on site, provide steel sleeves at joints. Accurately align and continuously weld entire joint. Grind welds to flat plane, fill with metallic paste filler and sand to uniform smooth finish. Make field joints inconspicuous after assembly. Mechanical fasteners not permitted.

.6 Fill exterior frames solid with low-density spray applied polyurethane insulation.

.7 Caulk perimeter of frames between frame and adjacent material.

.8 Maintain continuity of air barrier and vapour retarder.

.9 Fully grout frames in cast-in-place concrete and concrete masonry unit walls with non-shrink grout. Co-ordinate grouting of frames to adjacent concrete construction. Use hand-troweling

methods. Brace frames so pressure of grout before setting will not deform frames. Install door silencers in frames before grouting.

3.3 Door Installation

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.

.2 Hollow Metal Doors: Fit swing hollow metal doors accurately in frames, within clearances specified below Shim as necessary.

.1 Non-Fire-Rated Standard Steel Doors:

.1 Jambs and Head: 3 mm plus or minus 1.6 mm.

.2 Between Edges of Pairs of Doors: 3 mm plus or minus 1.6 mm.

.3 Between Bottom of Door and Top of Finish Floor (No door sweep): Maximum 6 mm.

.2 Fire-Rated Doors: Install doors with clearances according to NFPA 80, except maximum 6 mm clearance at bottom of door to top of finished floor.

.3 Smoke-Control Doors: Install doors according to NFPA 105.

.3 Adjust operable parts for correct function.

.4 Install louvres.

3.4 Finish Repairs

.1 Touch up with primer finishes damaged during installation.

.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

END OF SECTION

OVERHEAD COILING DOORS

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Interior fire-rated service doors.

.2 Related Requirements:

.1 Section 05 50 00 - Metal Fabrications, for miscellaneous steel supports.

.2 Divisions 26 and 28 Sections for connections to smoke detectors.

1.2 Action and Informational Submittals

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

.2 Product Data: For each type and size of overhead coiling door and accessory. Include the following:

.1 Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.

.2 Rated capacities, operating characteristics, and furnished accessories.

.3 For fire-rated doors, description of fire-release system including testing and resetting instructions.

.3 Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

.1 Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

.2 Show locations of replaceable fusible links.

.3 Wiring Diagrams: For signal, and control wiring.

.4 Samples: Manufacturer's finish charts showing full range of colours available for units with factory-applied finishes.

.5 Qualification Data: For qualified installer.

1.3 Closeout Submittals

.1 Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.4 Quality Assurance

.1 Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

.2 Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to ULC-S104.

1.5 Delivery, Storage and Handling

.1 Waste Management:

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

2. PRODUCTS

2.1 Overhead Coiling Door Assembly – Drawing No. U2-B301 and U2-B502

.1 Acceptable Products: Overhead Door Co. FireKing Model 631, Wayne Dalton Firestar 700, Cookson FD-P, Cornell ERD-10.

.2 Overhead Coiling Door: Fabricate overhead coiling-door curtain of interlocking metal slats, 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.

.3 Door Curtain Material: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with Z275 zinc coating.

.4 Door Curtain Slat Profile: Flat profile slats of 67-mm centre-to-centre height.

.5 Fire Rating: Refer to Drawing.

.6 Endlocks: 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 Bottom Bar: Consisting of two angles, each not less than 38 by 38 by 3 mm thick; fabricated from manufacturer's standard hot-dip galvanized steel to match curtain slats and finish.

.8 Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

.9 Hood: Match curtain material and finish. Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Roll and reinforce top and bottom edges

for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

.1 Mounting: As shown on Drawings.

2.2 Curtain Accessories

.1 Smoke Seals: Equip each fire-rated door with smoke-seal perimeter gaskets for smoke and draft control as required for door listing and labeling by a qualified testing agency.

.2 Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

.1 Provide pull-down straps or pole hooks for doors more than 2130 mm high.

.3 Automatic-Closing Device for Fire-Rated Doors: Equip each fire-rated door with an automatic-closing device that is inoperative during normal door operations and that has a governor unit complying with NFPA 80 and an easily tested and reset release mechanism without requiring special tools, designed to be activated by the following:

.1 Primary Activation Device: Building fire-detection and -alarm systems and manufacturer's standard door-holder-release devices.

.2 Secondary Activation Device: Replaceable fusible links with temperature rise and melting point of 74°C interconnected and mounted on both sides of door opening.

.3 Arrange automatic closing device to permit manual lifting of door for emergency exit after automatic closing with curtain returning to closed position when released.

2.3 Counterbalancing Mechanism

.1 General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

.2 Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 2.5 mm/m of span under full load.

.3 Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

.4 Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

.5 Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.4 Manual Door Operators

.1 Equip door with manufacturer's recommended manual door operator.

.2 Push-up Door Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 111 N.

2.5 Door Finish

.1 Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness. Colour as selected by the City from manufacturer's full range.

3. EXECUTION

3.1 Examination

.1 Examine substrates areas and conditions, with installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

.2 Examine locations of electrical connections.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

.1 Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

.2 Install overhead coiling doors, and hoods at the mounting locations indicated for each door.

.3 Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

.4 Fire-Rated Doors: Install according to NFPA 80.

.5 Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

3.3 Startup Service

.1 Engage a factory-authorized service representative to perform start-up service.

.1 Perform installation and startup checks according to manufacturer's written instructions.

.2 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

.3 Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 Adjusting

.1 Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

.2 Lubricate bearings and sliding parts as recommended by manufacturer.

3.5 Demonstration

.1 Engage a factory-authorized service representative to train the City's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTIONAL DOORS

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Electrically operated insulated steel overhead sectional doors.

.2 Related Requirements:

.1 Section 05 50 00 – Metal Fabrications for miscellaneous steel supports.

.2 Division 26 – Electrical, for electrical service and connections for powered operators and accessories.

1.2 Action and Informational Submittals

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

.2 Product Data: Submit manufacturer's instructions, printed product literature and data sheets for doors, hardware, control system, and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

.1 Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

.2 Wiring Diagrams: For power, signal, and control wiring, all interrelated components including, but not limited to remote actuation buttons and door command controls.

.4 Samples: Submit manufacturer's finish charts showing full range of colours and textures available for units and accessories with factory-applied finishes.

1.3 Closeout Submittals

.1 Provide operation and maintenance data for sectional metal doors and operators for incorporation into manual.

.1 Include manufacturer's parts lists; include servicing frequencies, instructions for adjustment and operation applicable to each type of component or hardware, and name, address and telephone number of nearest authorized service representative.

1.4 Delivery, Storage and Handling

.1 Delivery and Acceptance Requirements: deliver materials to Site in original factory packaging, labelled with manufacturer's name and address.

.2 Waste Management:

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

1.5 Warranty

.1 Manufacturer's standard form in which manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

.1 Failures include, but are not limited to, the following:

.1 Structural failures including, but not limited to, excessive deflection.

.2 Faulty operation of hardware.

.3 Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.

.4 Delamination of exterior or interior facing materials.

.2 Warranty Period: Ten (10) years for delamination, one (1) year for other components, from date of Substantial Completion.

.2 Manufacturer's standard form in which manufacturer agrees to repair or replace components of door operators that fail in materials or workmanship within specified warranty period.

.1 Warranty Period: Two (2) years from date of Substantial Completion.

2. PRODUCTS

2.1 Acceptable Products

.1 Subject to compliance with requirements, provide one of the following:

.1 Overhead Door Thermacore AP850.

.2 Wayne Dalton Thermomark 530.

.3 Richards-Wilcox Thermatite T300.

.4 Thermostop Energex Mark III-26.

.5 Clopay Model #3730.

2.2 Design Criteria

.1 Lateral Deflection of Door Sections: maximum 1/360 of span due to 0.45 kPa wind load pressure.

.2 Door in downward motion shall immediately stop and fully open upon contact with obstruction.

.3 Air Infiltration: Maximum rate not more than indicated when tested according to ASTM E 283 or DASMA 105.

.1 Air Infiltration: Maximum rate of 0.45 L/s per sq. m at 24 km/h.

.4 Design door panel assemblies: thermal insulation factor 4.58 RSI, when tested in accordance with ASTM C177 or ASTM C518.

2.3 Door Assembly

.1 Sectional steel door formed with hinged insulated door sections.

.1 Insulated Door Sections: Sandwich panel consisting of minimum 0.40 mm, ribbed profile galvanized sheet steel outer face, foamed-in-place insulation, and 0.40 mm, flush profile galvanized sheet steel interior liner. Overall thickness: 76 mm.

.2 Fabricate faces and liners from single sheets. Roll horizontal meeting edges to form double tongue and groove joint weather seal complete with continuous thermal break separating the exterior and interior faces of door.

.3 Insulate interior of steel sections with CFC-free foamed-in-place polyurethane insulation to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load. Enclose insulation completely within steel sections per ULC/ORD-C263.7.

.4 End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet complete with PVC thermal break.

.5 Reinforcement:

.1 Continuous steel strips at top and bottom of sections for hinge attachment.

.2 Continuous sheet steel channel or angle at bottom edge of bottom section.

.3 Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place.

.2 Operation Cycles: 20,000 cycles per annum.

.3 Installed U-value: minimum 0.8 W/m^2 deg C.

.4 Track Configuration: Standard-lift.

.5 Windows: Triple wall clear polycarbonate sealed units, located as indicated on Drawings. Nominally 600 wide by 300 mm high. Colour match frame of glazing to door colour.

.6 Operation: Electric.

.7 Locking System: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only with interlock switch for automatic operator.

2.4 Track System

.1 Track system Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances shown on Drawings. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track spaced 51 mm apart for door-drop safety device. Slope tracks at proper angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.

.1 Material: roll-formed sheet steel, hot dip galvanized or electrogalvanized.

.2 Track Reinforcement and Supports: Galvanized-steel track reinforcement and support members. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.

.1 Vertical Track Assembly: Track with continuous reinforcing angle attached to track and attached to wall with jamb brackets.

.2 Horizontal Track Assembly: Track with continuous reinforcing angle attached to track and supported at points from curve in track to end of track by laterally braced attachments to overhead structural members.

.3 Track Size: 75 by 2.7 mm thick.

2.5 Hardware

.1 General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

.2 Hinges: Heavy duty, hot dip galvanized or electrogalvanized steel at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges where required, for doors over 4.88 m wide unless otherwise recommended by door manufacturer.

.3 Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 76-mm diameter roller tires for 76-mm- wide track.

.4 Lifting Handles: For push-up or emergency-operated doors, provide galvanized-steel lifting handles on each side of door.

.5 Weatherstripping:

.1 Materials: combination extruded aluminum and arctic grade vinyl.

.2 Door Bottom: EPDM bulb-type.

.3 Jambs and Head: double flapper and bulb seal.

2.6 Counterbalancing Mechanism

.1 Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.

.2 Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 4.88 m long and two additional brackets at one-third points to support shafts more than 4.88 m long unless closer spacing is recommended by door manufacturer.

.3 Cables: Galvanized-steel lifting cables with cable safety factor of at least 7 to 1.

.4 Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.

.5 Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.

.6 Provide spring bumper at each horizontal track to cushion door at end of opening operation.

2.7 Finishes

.1 Manufacturer’s standard factory-applied two-coat baked on polyester. Colour selected by the City from manufacturer’s standard range.

2.8 Manual Door Operators

.1 Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.

.2 Push-up Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 111 N.

.3 Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 111-N force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.9 Electric Door Operators

.1 General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, built-in logic controller, control devices, integral gearing for locking door, and accessories required for proper operation.

.1 Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with maximum 24-V ac or dc control circuit.

.2 Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

.3 Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.

.1 Trolley: Trolley operator mounted to ceiling above and to rear of door in raised position and directly connected to door with drawbar.

.2 Jackshaft, Centre Mounted: Jackshaft operator mounted on the inside front wall above door and connected to torsion shaft with an adjustable coupling or drive chain.

.3 Jackshaft, Side Mounted: Jackshaft operator mounted on the inside front wall on right or left side of door and connected to torsion shaft with an adjustable coupling or drive chain.

.4 Electric motors, controller units, remote push button stations, relays and other electrical components: CSA approved.

.1 Power Supply: 575 V, 3 phase, 60 Hz.

.2 Motor Type and Controller: Reversible motor and controller (disconnect switch).

.3 Motor Size: Large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 200 mm/s and not more than 300 mm/s, without exceeding nameplate ratings or service factor.

.4 Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

.5 Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

.6 Use adjustable motor-mounting bases for belt-driven operators.

.5 Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

.6 Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

.1 Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

.1 Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensor device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.

.7 Push Button Station: momentary-contact, three button control station with push button controls labelled "open", "close" and "stop". Mount on wall where directed or as indicated.

.1 Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

.2 Quantity: one per door.

.8 Equip operator with adjustable friction clutch and solenoid brake.

.9 Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 111 N.

.10 Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

3. EXECUTION

3.1 Examination

.1 Verification of Conditions: verify conditions of substrates are acceptable for sectional metal doors installation in accordance with manufacturer's written instructions.

.2 Examine locations of electrical connections.

.3 Inform the City of unacceptable conditions immediately upon discovery. Proceed with installation only after unacceptable conditions have been remedied.

3.2 Installation

.1 Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

.2 Tracks:

.1 Fasten vertical track assembly to opening jambs and framing.

.2 Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

.3 Repair galvanized coating on tracks.

.3 Install operator including electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door operation.

.4 Install door free of noticeable vibration under normal usage and design wind loading.

3.3 Startup Services

.1 Engage a factory-authorized service representative to perform startup service.

.1 Complete installation and start-up checks according to manufacturer's written instructions.

.2 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 Adjusting

.1 Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

.1 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

.2 Lubricate bearings and sliding parts as recommended by manufacturer.

.3 Adjust doors and seals to provide weathertight fit around entire perimeter.

.4 Align and adjust motors, pulleys, belts, sprockets, chains, and controls according to manufacturer's written instructions.

.2 Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing.

3.5 Demonstration and Training

.1 Engage factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain sectional doors and operators.

END OF SECTION

DOOR HARDWARE

1. GENERAL

1.1 Summary

.1 Related Requirements:

.1 Section 08 11 13 - Hollow Metal Doors and Frames.

.2 Section 08 33 23 - Overhead Coiling Doors.

1.2 Administrative Requirements

.1 Coordination: Furnish wood and metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware and for hardware installation.

1.3 Action and Informational Submittals

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

.2 Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

.3 Shop Drawings: Details of electrified door hardware, indicating the following:

.1 Wiring Diagrams: For power, signal, and control wiring and including details of interface of electrified door hardware and building safety and security systems.

.2 Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

.4 Samples: Submit each type hardware specified, when requested by the City. Identify each sample by label indicating applicable specification paragraph number, finish, and hardware package number.

.5 Door Hardware Schedule: Prepared by or under the supervision of installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

.1 Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.

.6 Product Certificates: For electrified door hardware, from the manufacturer. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

.7 Manufacturer's instructions.

1.4 Closeout Submittals

.1 Maintenance Data: For hardware to include in maintenance manuals.

.1 Include final hardware schedule.

.2 Provide maintenance data, parts list, and manufacturer's instructions for each type door closers, locksets, door holders, and panic hardware for incorporation into maintenance manual.

.3 Brief maintenance staff regarding proper care of hardware such as lubrication of locksets, adjustments of door closers, cleaning, and general maintenance.

.4 Provide two (2) sets of wrenches and slot key for door closures, exit devices, and privacy locksets.

1.5 Quality Assurance

.1 Source Limitations: Obtain each type of door hardware from a single manufacturer.

.2 Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a Canadian Certification Organization accredited by Standards Council of Canada, for fire-protection ratings indicated.

.3 Accessibility Requirements: For door hardware on doors in an accessible route, comply with 2015 City of Winnipeg Accessibility Design Standards.

1.6 Delivery, Storage and Handling

.1 Inventory door hardware on receipt. Provide clean, dry and secure lock-up for door hardware delivered to Project Site.

.2 Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

.3 Waste Management:

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

2. PRODUCTS

2.1 Manufacturers

.1 Acceptable Products:

.1 Butt Hinges: McKinney & Stanley.

.2 Locksets: Medeco / Assa Abloy key system. Utilize a Schlage heavy duty key in knob set with Medico keyway, Satin Chrome finish.

.3 Flushbolts: Standard Metal.

.4 Floor stop: Standard Metal & Glynn Johnson.

.5 Door Sweep: KN Crowded.

.6 Threshold: KN Crowded.

.7 Astragal: KN Crowded.

.8 Door Closer: Norton & LCN.

.9 Exit Device: Von Duprin.

.10 Kick plates: Standard Metal.

.11 Perimeter Seals: KN Crowder.

.12 Hold Opens: Simplex.

.2 Access Control System:

.1 The Access Control System will be consistent with City of Winnipeg facility access control system which utilizes the Genetec Synergic system.

.2 The access cards to be used for access are the City of Winipeg employee Identification Access Cards, which are based on HID technology.

.1 Cabinet: Lifesafety FPO 150/150-C8D8E2.

.2 Interface Module: Genetec MR52.

.3 Controller: Genetec LP1502 Controller card.

.4 Power Supply: EATON UPS for system and all associated components. UPS may be shared with other systems, unless precluded by other requirements.

.5 Card Reader: multiclass SE Readers: RP40 or RK40 for dual authentication.

.6 Electric Strike: HES Electric Strike or Von Duprin Door Hardware; Astragal plate for latch:

.1 Note: all exterior doors with Card access Control shall be configured “fail secure”. Mechanical panic bars shall be provided for egress.

.7 Door Monitoring Contact: single pole monitoring contacts for all doors with access control, or as required by other specifications.

.8 Interior Door Exit Detector: All interior doors with access control shall be provided with a T-REX exit detector.

.9 Cabling: Honeywell profusion access cable. Wiring for electric door strike sized for voltage drop. Provide Category 6 cable (CAT-6) for future Power over Ethernet technology to each door with access control.

.3 Specific model numbers/details: listed in article “HARDWARE GROUPS”.

.4 Substitutions: not permitted.

.5 Provide fire labeled hardware for fire-resistance rated openings.

2.2 Scheduled Door Hardware

.1 Interior, Non-Exit Doors:

	Item	**Model**		**Finish**	**Manufacturer**
1	Hinges	TA 314	4 ½ x 4 NRP	26D	Mc Kinney
2	Lockset	AU	5407 x ASA	26D	Abloy / Medeco
3	Flushbolts	F65		26D	Standard Metal
4	Floor stop	S113		26D	Standard Metal
5	Door Sweep	W245	36”	CA	KN Crowder
6	Threshold	CT11	72”	CA	KN Crowder
7	Astragal	W40P	84”	CA	KN Crowder
8	Closer	7500		689	Norton

.2 Exterior, Exit Doors with Access Control System:

	Item	**Model**		**Finish**	**Manufacturer**
1	Hinges	CB168	4 ½ x 4 ¼	26D	Stanley
2	Exit Device	98NL-F		US26D	Von Duprin
3	Closer	4020		US26D	LCN
4	Floor Stop	S101 Series		626	Standard Metal
		90S	4	US32D	Glynn Johnson
5	Kick plates	K10A	x door width less 50 mm	C32D	Standard Metal
6	Perimeter Seals	CT50			KN Crowder
7	Hold Opens	2088-9589	Wall mount		Simplex

2.3 Hardware Groups

.1 Refer to Drawing No. U2-B601 – Door and Frame Schedule for the specified hardware groups. Supply the hardware as listed for the scheduled doors.

2.4 Fastenings

.1 Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

.2 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

.3 Use fasteners compatible with material through which they pass.

2.5 Keying System

.1 The City will supply, prepare, masterkey, and install cylinders.

.1 New buildings and major renovations: Medeco / Assa Abloy cylinders.

.2 Minor renovations in existing building: Medeco / Assa Abloy, Schlage restricted keyway, or Sargent Keso as determined by the City's locksmith.

.2 The City will supply, identify and distribute keys.

.1 Grandmaster Key (GMK): The key can open all the doors in the NEWPCC facility.

.2 Master Key: The key can open selected groups of doors.

.3 Change Key: Each lockable room will have its own Chage Key.

3. EXECUTION

3.1 Examination

.1 Examine doors and frames, with installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting.

.2 Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Door and Frame Protection

.1 Patch, fill, sand and prepare existing doors and frames to provide a clean, smooth substrate to suit new door and frame protection.

3.3 Installation

.1 Installation of door hardware is the responsibility of the door hardware supplier, with the exception of cylinders.

.2 Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

.3 Do not use “Lock-tite” or other sealants during hardware installation.

.4 Hinges:

.1 Doors up to 914 mm wide by 2200 mm high: 1 1/2 pairs of butts.

.2 Doors over 914 mm wide or 2200 mm high: 2 pairs of butts.

.5 Install hardware at following heights from finished floor to centre line of item:

.1 Door Pull: 1067 mm to top of pull.

.2 Push Plate: 1067 mm to top of plate.

.3 Push Bar: 1067 mm.

.4 Door Lever: 1024 mm.

.5 Dead Lock: 890 mm.

.6 Panic Bar: 1012 mm to cross bar.

.7 Peephole: 1450 mm.

.6 Where doorstop contacts door pulls, mount stop to strike bottom of pull. Mount wall stops to solid blocking within wall. Provide blocking and wall repairs where required.

.7 Install kickplate on push side of door unless specified otherwise. Install with countersunk oval head stainless steel screws.

.8 Upon completion of hardware installation and adjustment, submit written certification to the City that hardware has been installed as specified.

3.4 Site Quality Control

.1 The City may engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

.2 Remove and replace non-compliant products with specified product at no cost to the City. Costs associated with use of non-compliant hardware are the responsibility of the Contractor.

.3 If “Lock-tite” or other sealants are found to be used during hardware installation, the Contractor may be requested to replace hardware at no cost to the City.

.4 Upon completion of hardware installation and adjustment, provide written certification from hardware supplier that hardware has been installed as specified.

3.5 Cleaning

.1 Clean adjacent surfaces soiled by door hardware installation.

.2 Clean operating items as necessary to restore proper function and finish.

3.6 Adjustment

.1 Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

END OF SECTION

PAINTING

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Interior painting and repainting.

.2 Related Requirements:

.1 Identification of mechanical and electrical systems is specified in Divisions 22-28.

1.2 Administrative Requirements

.1 Coordination:

.1 Coordinate and confirm specific surface preparation procedures and primers used for fabricated steel items from fabricator/supplier to determine appropriate and compatible finish coat materials before painting any such work.

.2 Scheduling:

.1 Submit work schedule for various stages of painting to the City for approval. Submit schedule minimum of forty-eight (48) hours in advance of proposed operations.

.2 Obtain written authorization from the City for any changes in Work schedule.

.3 Schedule interior painting operations to prevent disruption of occupants in and about the building.

.4 Schedule painting in occupied areas in accordance with the City's operation requirements on weekends, evenings, or outside normal working hours. Schedule operations to approval of the City such that painted surfaces will have dried and cured sufficiently before occupants are affected.

1.3 Action and Informational Submittals

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

.2 Product data: submit list of brand name products that Contractor intends to use on each part of the Work.

.3 Samples:

.1 Submit three (3) drawdowns of each product and colour combination. Drawdowns shall be applied using 4 mil WFT drawdown bar on Leneta form WD plain white coated cards, size 100 by 150 mm, mounted on 216 by 280 mm sheets.

.2 For natural and stained finishes on wood: Submit duplicate samples of specified finish on specified wood species.

.3 When approved, sample panels shall become acceptable standard of quality for appropriate on-Site surface with one of each sample retained on-Site.

.4 Label each card with the following:

.1 Job name.

.2 Date.

.3 Product name.

.4 Product number.

.5 Colour number as stated in the colour schedule.

.6 Name, address, and phone number of the supplying facility.

.5 Submit full range of available colours where colour availability is restricted.

.4 Schedule: If requested, submit schedule for various stages of work when painting occupied areas for the City's review and approval.

.5 WHMIS MSDS.

1.4 Closeout Submittals

.1 Maintenance Data: Submit maintenance data for incorporation into Operations and Maintenance Manual.

.2 Submit records of products used. List products in relation to finish system and include the following:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

.4 MPI environmentally friendly classification system rating.

.5 Manufacturer's Material Safety Data Sheets (MSDS).

1.5 Extra Stock Materials

.1 Furnish extra materials that match products installed and that are identified with labels describing contents.

.2 Provide one 4-litre container of each colour and sheen used on Project.

.3 Label each container with colour, sheen, room location, and date.

1.6 Quality Assurance

.1 Qualifications: minimum of five (5) years proven satisfactory experience specializing in commercial painting and finishing. When requested, provide a list of last three (3) comparable jobs including, job name and location, owner and project manager, contractor, start and completion dates, and value of painting work.

.1 Use only qualified journeyperson. Apprentices may be employed provided they work under the direct supervision of a qualified journeyperson.

.2 Conform to latest MPI requirements for painting work including materials, preparation, and quality of work.

.3 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by the City.

.4 Obtain approval of paints, varnishes, protective coatings and materials for mixing and thinning from the City prior to application.

.5 Mock-up:

.1 Prepare and paint a designated interior surface, area, room or item (in each colour scheme) to specified requirements, with specified paint or coating showing selected colours, sheen, textures and workmanship for review by the City.

.2 When accepted, mock-up shall become acceptable standard of finish quality and workmanship for similar on-Site painting Work.

.6 Standard of Acceptance:

.1 Walls: No defects visible from a distance of 1000 mm at 90 degree to surface.

.2 Ceilings: No defects visible from floor at 45 degree to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.7 Delivery, Handling and Storage

.1 Deliver and store materials in original containers, sealed, with labels intact. Labels shall clearly indicate:

.1 Manufacturer's name and address.

.2 Type of paint or coating.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

.2 Remove damaged, opened and rejected materials from Site.

.3 Provide and maintain dry, temperature controlled, secure storage.

.4 Observe manufacturer's recommendations for storage and handling.

.5 Store materials and supplies away from heat generating devices.

.6 Store materials and equipment in a well ventilated area with temperature range 7°C to 30°C.

.7 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.8 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of the City. After completion of operations, return areas to clean condition to approval of the City.

.9 Remove paint materials from storage only in quantities required for same day use.

.10 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

.11 Fire Safety Requirements:

.1 Provide Type ABC fire extinguisher adjacent to storage area.

.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from Site on a daily basis.

.3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

.12 Take necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect the environment from hazard spills.

1.8 Waste Management and Disposal

.1 Dispose materials that cannot be reused. Treat as hazardous waste in appropriate manner.

.2 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.3 Reduce amount of contaminants entering waterways, sanitary/storm drain systems as follows:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out. Do not clean equipment using free draining water.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.

.5 Dry empty paint cans before recycling or disposing.

.6 Close and seal tightly partly used cans of materials including sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

.4 Collect waste paint by type and provide for delivery to recycling or collection facility or dispose of at hazardous waste facility.

1.9 Site Requirements

.1 Heating, Ventilation and Lighting:

.1 Ventilate enclosed spaces.

.2 Where required, provide continuous ventilation after completion of application of paint.

.3 Perform no painting work unless adequate and continuous ventilation and is in place to maintain ambient air and substrate temperatures above 15 °C for twenty-four (24) hours before, during and after paint application until paint has cured sufficiently.

.4 Coordinate use of existing ventilation system with the City and ensure its operation during and after application of paint as required.

.5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.6 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted.

.2 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Do not paint unless sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 15°C for twenty-four (24) hours before, during and after paint application until paint has cured sufficiently.

.2 Do not paint when:

.1 Substrate temperature is over 3°C unless paint is specifically formulated for application at high temperatures.

.2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.

.3 Relative humidity is above 85% or when the dew point is less than 3°C variance between the air/surface temperature.

.3 Do not paint when the maximum moisture content of the substrate exceeds:

.1 12% for concrete and masonry (clay and concrete brick/block).

.2 15% for wood.

.3 12% for plaster and gypsum board.

.4 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".

.5 Test concrete, masonry and plaster surfaces for alkalinity as required.

.3 Surface and Environmental Conditions:

.1 Apply paint finish only in areas where dust is no longer being generated by related construction operations or when ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint only to adequately prepared surfaces and to surfaces within moisture limits noted herein.

.3 Apply paint only when previous coat of paint is dry or adequately cured.

.4 Additional Interior Application Requirements:

.1 Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

.5 Additional Exterior Application Requirements:

.1 Apply paint finishes when conditions forecast for entire period of application fall within manufacturer's recommendations.

.2 Do not apply paint when:

.1 Temperature is expected to drop below 10°C before paint has thoroughly cured.

.2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.

.3 Surface to be painted is wet, damp or frosted.

.3 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.

.4 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.

.5 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

2. PRODUCTS

2.1 Materials

.1 Materials (primers, paints, coatings, fillers, thinners, solvents, etc.): highest quality product of an approved manufacturer, and from a single manufacturer for each system used.

.1 Acceptable manufacturers: Sherwin Williams/General Paint, PPG/Dulux.

.2 Other materials such as linseed oil, shellac, turpentine: highest quality product of an MPI listed manufacturer, compatible with paint materials being used.

.3 Lead- and mercury-free, low or no VOC content where possible.

.4 Where required, paints and coatings shall meet flame spread and smoke developed ratings designated by local Code requirements or authorities having jurisdiction.

.5 Slip Resistant Additive (SRA): rubber aggregate, clean/washed silica sand or ground walnut chips (interior dry areas only) for use with or as a component part of paint on horizontal surfaces as required to provide slip resistance.

.6 Glass Reflective Beads (for pavement marking): of type suitable for application to wet paint surface for light reflectance.

2.2 Colours

.1 Unless otherwise specified, provide MPI Premium Grade paint system.

.2 The City will provide Colour Schedule (WSTP Paint Standard) after Contract award.

.3 Selection of colours will be from manufacturers' full ranges of colours. Refer to Finish Schedule for identification and location of colours.

.4 Generally and unless otherwise specified or noted on Finish Schedule the quantity of colours and finishes shall be based on the following criteria:

.1 Interior colours will be based on five base colours and three accent colours with a maximum of one 1 deep or bright colour. No more than eight colours will be selected for the entire project and no more than three colours will be selected in each area, not including pre-finished items.

.2 Unless otherwise indicated, paint walls the same colour within a given area.

.3 Ceilings: paint white unless indicated otherwise.

.4 Paint access doors, prime coated hardware, registers, radiators and covers, exposed piping and electrical panels to match adjacent surfaces including colour, texture and sheen, unless otherwise noted or where pre-finished.

.5 Back-prime, and paint plywood service panels including edges flat grey or to match surrounding wall as directed.

.6 Paint inside of light valances gloss white.

.7 Paint inside of duct work behind louvres, grilles and diffusers a minimum of 460 mm or beyond sight line, whichever is greater, using flat black non-reflecting paint.

.5 Where specific products are available in a restricted range of colours, selection will be based on the limited range.

.6 Second coat in a three (3) coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 Mixing and Tinting

.1 Perform colour tinting operations prior to delivery of paint to Site. Re-mix paint in containers before and during application to break-up lumps, and ensure complete dispersion of settled pigment, and colour and gloss uniformity.

.2 Mix paste, powder or catalyzed paint mixes in strict accordance with manufacturer's written instructions.

.3 Do not exceed paint manufacturer’s recommendations where thinner is used. Do not use kerosene or any such organic solvents to thin water-based paints.

.4 Thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to the City.

2.4 Gloss/Sheen Ratings

.1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following values:

Gloss Level Category	**Units @ 60 deg**	**Units @ 85 deg**
G1 - matte finish	0 to 5	max. 10
G2 - velvet finish	0 to 10	10 to 35
G3 - eggshell finish	10 to 25	10 to 35
G4 - satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 - gloss finish	70 to 85	
G7 - high gloss finish	> 85	

.2 Gloss level ratings of painted surfaces: as specified or indicated in the Finish Schedule.

.3 Repainting and patchwork: gloss level of patchwork to match existing surfaces as closely as possible.

2.5 Interior Painting Systems

.1 Concrete Vertical Surfaces: including ceilings and undersides of balconies and stairs, etc.:

.1 INT 3.1P - Epoxy high build G5 finish.

.2 Concrete Horizontal Surfaces:

.1 INT 3.2F - Concrete floor sealer.

.3 Concrete Masonry Units: concrete block and concrete brick:

.1 INT 4.2R - Epoxy high build (over epoxy block filler) G5 finish.

.4 Structural Steel and Metal Fabrications:

.1 INT 5.1D - Alkyd dry fall (over quick dry alkyd primer) G5 finish.

.2 INT 5.1DD - Alkyd dry fall (over alkyd primer) G5 finish.

.3 INT 5.1E - Alkyd (over alkyd quick dry primer) G5 finish.

.4 INT 5.1EE - Alkyd (over alkyd primer) G5 finish.

2.6 Interior Repainting Systems

.1 Match with Interior Painting systems.

2.7 Exterior Painting Systems

.1 Galvanized Metal: not chromate passivated High contact/high traffic areas = doors, frames, railings, misc. steel, pipes, etc.). Low contact/low traffic areas = overhead decking, eavestroughs, downpipes, ducts, etc.:

.1 EXT 5.3H - Latex (over water based galvanized primer) (low contact/traffic) G5 finish.

3. EXECUTION

3.1 General

.1 Perform preparation and operations for interior painting and repainting in accordance with MPI Architectural Painting Specifications Manual, and MPI Maintenance Repainting Manual, except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.2 Existing Conditions

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report damages, defects, unsatisfactory or unfavourable conditions to the City before proceeding with Work.

.2 Do not start work until adverse conditions and defects have been corrected and surfaces and conditions are acceptable.

.3 Conduct moisture testing of surfaces to be painted using a properly calibrated electronic moisture meter, except test concrete floors for moisture using a simple "cover patch test" and report findings to the City. Do not proceed with Work until conditions fall within acceptable range as recommended by manufacturer.

.4 Maximum moisture content as follows:

.1 Gypsum Board, concrete, concrete masonry, brick: 12%.

.2 Wood: 15%.

.5 For existing surfaces, assess degree of surface deterioration in accordance with MPI Maintenance Repainting Manual.

.1 Include costs of repair of DSD-1 through DSD-3 defects in the Work.

.2 Do not repaint surfaces until DSD-4 defects have been corrected.

3.3 Protection

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking.

.2 If damaged, clean and restore such surfaces as directed by the City.

.3 Protect items that are permanently attached such as fire labels on doors and frames.

.4 Protect factory finished products and equipment.

.5 Protect passing pedestrians, building occupants and general public in and about the building.

.6 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking any painting operations. Securely store items and re-install after painting is completed.

.7 Occupied areas:

.1 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.2 As painting operations progress, place "WET PAINT" signs to approval of the City.

3.4 Preparation

.1 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual, and MPI Maintenance Repainting Manual requirements. Refer to MPI manuals in regard to specific requirements, and as follows:

.1 Remove dust, dirt, and other surface debris by vacuuming, brushes or wiping with dry, clean cloths.

.2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly.

.5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.

.2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pre-treatment as soon as possible after cleaning and before deterioration occurs.

.3 Where possible, prime surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.

.1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.

.2 Apply wood filler to nail holes and cracks.

.3 Tint filler for stained woodwork.

.4 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes or vacuum cleaning.

.5 Confirm preparation and primer used with fabricator of steel items. Touch up of shop primers with primer as specified in applicable section. Major touch-up including cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas, shall be by supplier of fabricated material.

.6 Do not apply paint until prepared surfaces have been accepted by the City.

3.5 Application

.1 Method of application to be as approved by the City. Apply paint by brush or roller. Conform to manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application:

.1 Apply paint in a uniform layer using brush or roller of types suitable for application.

.2 Work paint into cracks, crevices and corners.

.3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.

.4 Brush or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple unless approved by the City.

.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access and only when specifically authorized by the City.

.4 Apply coats of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.5 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

.7 Number of coats of paint specified are intended to cover surface completely. If necessary apply additional coats until satisfactory coverage is obtained. Additional coats without cost to the City.

.8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.

.9 Finish closets and alcoves as specified for adjoining rooms.

.10 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

.11 Prime and seal areas to receive adhesive-applied finishes including wall covering and rigid wall protection.

.12 Completely finish all surfaces of doors, including areas to receive door protection.

.13 Prime and paint wall surfaces completely down to floor line. Prior to painting, confirm wall and joints are finished to floor line, with cracks and crevices filled and smoothed to facilitate good installation and proper adhesion of coved flooring to wall.

3.6 Mechanical/Electrical Equipment

.1 Finished areas: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted or specified otherwise.

.2 Mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.

.3 Unfinished areas: leave equipment, piping, conduits, etc. in original finish and touch up scratches and marks.

.4 Do not paint over nameplates.

.5 Keep sprinkler heads free of paint.

.6 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.

.7 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

.8 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

.9 Do not paint interior transformers and substation equipment.

.10 Repainting: Unless otherwise noted, repaint exposed-to-view previously painted interior mechanical and electrical equipment and components (panels, conduits, piping, hangers, ductwork, etc.)

3.7 Existing Work

.1 Preparation of previously painted surfaces:

.1 Remove loose or flaked paint or paper.

.2 Remove dirt, dust, grease, oil, etc.

.3 Dull glossy areas with sandpaper.

.4 Fill minor cracks with plaster patching compound. Sand smooth and wipe clean.

.5 Spot prime patched areas with finishing coat.

.6 Finish as specified for new work.

.2 Wherever painting of existing walls is scheduled or indicated, paint both sides of doors and frames, or other items requiring painting which occur within that wall.

.3 Painting of patchwork shall include for painting of existing surfaces up to nearest change in direction or surface interruption (example: door jamb, corner, bulkhead). Make neat termination, match paint as closely as possible.

.4 Paint both sides of all new partitions regardless of whether both sides are indicated in Finish Schedule.

.5 Paint both sides of new doors and frames, screens, windows or any other items requiring painting which are installed in existing walls. Remove doors before repainting to paint bottom and top edges.

3.8 Restoration

.1 Clean and re-install all hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashes on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of the City. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by the City.

END OF SECTION

SPECIAL COATINGS

1. GENERAL

1.1 Description

.1 Provide special coatings as indicated and in compliance with Contract Documents.

.1 Coated surfaces to include:

.1 Existing UV channel interior concrete wall as described on the Drawings.

1.2 References

.1 ASTM International (ASTM):

.1 ASTM C 418 Abrasion resistance of concrete by sandblasting.

.2 C882: Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

.3 D638:Standard Test Method for Tensile Properties of Plastics.

.4 D3359: Standard Test Methods for Measuring Adhesion by Tape Test.

.5 D4541: Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

.6 ASTM D-4787: Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.

.7 ASTM D7234: Tensile adhesion test for coatings on concrete surfaces.

.8 E377: Standard Practice for Internal Temperature Measurements in Low-Conductivity Materials.

.2 The Society for Protective Coatings (SSPC):

.1 SP1: Solvent Cleaning.

.2 SSPC-SP-2: Hand tool cleaning.

.3 SSPC SP-3: Power tool cleaning..

.4 SSPC AB-1: Mineral and Slag abrasives.

.5 SSPC Good painting practices Volume 1 4th Edition.

.6 SP13: Surface Preparation of Concrete.

.7 SSPC- PA9 : Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages.

.3 National Association of Corrosion Engineers International (NACE):

.1 NACE SP0892-07: Coatings and Linings over Concrete for Chemical Immersion and Containment Service.

1.3 Submittals

.1 Submit Shop Drawings in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's product data including literature, specifications and data sheets stating application recommendations and generic makeup of each type of coating scheduled.

.2 Copies of quality control and inspection forms for cleaning, surface preparation, painting and pass/fail criteria.

.3 Third party inspector professional information and copy of valid NACE CIP Level 3 Certificate.

.3 Samples:

.1 Actual colour samples available for each type of coating scheduled.

1.4 Quality Assurance

.1 Applicator Qualifications:

.1 Engage an experienced applicator who has successfully completed coating system applications similar in material and extent to those indicated for Project.

.2 Ensure that mixing and installation of protective coating is performed by applicators approved or qualified by the coating manufacturer.

.3 Submit statement from the manufacturer's authorized technical representative certifying the Contractor is qualified to apply the protective coating.

.2 Single-Source Responsibility:

.1 Provide coating material produced by same manufacturer for each system. Use only thinners recommended by manufacturer and only within recommended limits.

1.5 Delivery, Storage and Handling

.1 Deliver material in original, sealed, unopened packages and containers bearing manufacturer's name. Each container shall have manufacturer's printed label stating type of coating, colour of coating, instructions for reducing, and spreading rate.

.2 Protect and heat or cool material storage location to maintain temperature ranges recommended by coating manufacturer for most sensitive coating, but not less than 13°C (55°F).

.3 All Primer and Coating material shall arrive on the jobsite in factory sealed and unopened containers. Batch numbers shall be recorded and within manufacturer's shelf life.

1.6 Service Conditions

.1 Furnish materials suitable for exposure to municipal raw sewage or wastewater sludge (i.e. fermented primary sludge) containing some industrial wastes and exposure to sludge gases.

.2 Raw sewage or wastewater sludge may contain gross waste solids, vegetable parts, sand, silt, petroleum products, industrial solvents, and animal fats and oils and methane, hydrogen sulphide and carbon dioxide.

.3 The expected raw sewage or wastewater sludge temperature range is 10°C to 60°C and pH may range from 4.5 to 8.5. Provide lining material impermeable to raw sewage, wastewater sludge and sludge gases, and non-conducive to bacterial or fungus growth.

.4 Liner to not only protect concrete surfaces but to provide both long term liquid and gas tightness. Installation to prevent migration of raw sewage, wastewater sludge, water or sludge gas through liner or between the liner and concrete.

1.7 Environmental Requirements

.1 Environmental Requirements:

.1 Do not apply exterior coating in cold, foggy, damp or rainy weather.

.2 Do not apply coating when temperature is lower than 16°C and when the ambient temperatures are less than 3°C above dew point. Relative humidity shall not exceed 95%. Do not apply coatings when conditions are not within recommended parameters, when snowing, raining or foggy or when precipitation is imminent.

.3 Comply with the Manufacturer’s recommendations as to environmental conditions under which resurfacing system materials can be applied.

.4 Do not apply resurfacing system materials when dust is in Work Site.

.5 Dehumidification and/or heating shall be provided to the satisfaction of the Contract Administrator should the Contractor request to install the coatings when environmental conditions are not within the Manufacturer’s recommended parameters. Such requests are subject to the Contract Administrator’s discretion.

.2 Protection:

.1 During surface preparation and coatings application, all nearby equipment, vehicles, structures, etc. shall be protected from blasting grit, dust and over-sprayed, dropped or spilled materials. Surfaces adjacent to a proposed leading edge (saw cut) of coating application shall be taped-off or otherwise protected and to be removed following polyurethane application. Consult coating manufacturer’s recommendation for saw cut procedure. It is essential the tape removal is completed before the lining system has cured hard.

.2 Cover materials and surfaces, including floors, adjoining or below Work with clean drop cloths or canvas.

.3 Remove hardware, accessories, plates, lighting fixtures, and similar items or provide protection by masking. Upon completion, replace above items or remove protection and clean.

.4 Maintain manufacturer’s environmental requirements while coating dries.

1.8 Manufacturer’s Recommendations

.1 Conform to Manufacturer's printed instructions for surface preparation including saw cut and tape removal procedures, use, safety requirements, mixing, application, curing and intercoat precautions for protective coating. Submit to Contract Administrator these instructions and manufacturer's product data sheets, thirty (30) days prior to application of coating.

2. PRODUCTS

2.1 Materials

.1 Provide only high-grade products of nationally known manufacturers having an established good reputation in the field. Provide products having a minimum of five (5) years satisfactory field service and suitable for the intended service. Provide only products of one manufacturer in any one (1) coating system. Touch-up with coatings as originally applied. Provide materials meeting air pollution requirements in the area where they are applied.

.2 Apply materials within the manufacturer's recommended shelf life.

.3 Submit list of coating products that will be used on the Project thirty (30) days prior to application of coatings.

.4 Deliver materials in their original, unopened containers plainly marked with the name and analysis of the product, the producer's name and the shelf life date. Do not use contaminated, outdated, prematurely opened, or diluted material. Do not modify or extend coatings and only use in accordance with the coating manufacturer's current printed instructions.

2.2 Concrete Tanks Protective Coating System (PC-1)

.1 The following table specifies the material requirement for the complete surfacing system at total of 102-106 mils minimum dry film thickness (DFT). The acceptable products are as follows:

	Stoncor Group (604-777-1225)	**International Protective Coatings (604-291-8242)**	**Dry Film Thickness**
Surface Cleaning	Carboline Surface Cleaner #3	Devprep 88	
Epoxy Resurfacer	Carboguard 510 or 501	Devfil 145	Apply thickness and coats as recommended by the Manufacturer as scratch coat to repair bug holes, irregular surfaces and voids.
Primer	Phenoline 311 (2-5 mils DFT)	Primall 160 (6-10 mils DFT)	Specific to each Primer
Solventless Type V Elastomeric Aromatic Polyurethane	Polibrid 705	Lifelast Durashield 310	Minimum 100 mils
Geotextile Fabric (Expansion Joints)	Carthage Mills, Cincinnati, OH (513-794-1600)	Non-woven, 100% polypropylene fabric, needle punched, and “heat-set” on one side, Fabric shall weigh 8 to 10 oz./yd.^{2} (250 to 313 g/m^2), or as appropriate for the intended use.	

.2 Performance Criteria for system – manufacturers must meet or exceed the following data:

.1 Abrasion ASTM D 4060- 1000 gram load <37 mg loss.

.2 Compressive Strength - ASTM D 579 - No less than 5,100 psi.

.3 Flexural Strength - ASTM D 790 - no less than 6000 psi.

.4 Adhesion ASTM – 4541 No less than 400 psi at 100 percent Concrete failure.

.5 Humidity - ASTM 4585 - 2000 hours no blistering, cracking or delamination.

.6 Immersion ASTM 870 - 2 years no blistering, cracking, rusting or delamination.

.7 Tensile Strength – ASTM D 638 - No less than 2800 psi.

2.3 Colours

.1 Colour shall be formed of pigments free of lead, lead compounds or other materials which might be affected by presence of hydrogen sulfide or other gases which may be present at place of Work.

.2 Colours shall be approved by the Contract Administrator.

3. EXECUTION

3.1 Examination

.1 Where surface dryness is questioned, test with dampness indicating instrument or ASTM D4263 Plastic Sheet Method. Do not apply coatings over surfaces where moisture content exceeds that permitted in manufacturer's printed instructions.

.2 Concrete surfaces shall not exceed the condensation and moisture criteria set by the Manufacturer prior to application of the epoxy primer.

3.2 Preparation

.1 Hoisting, Scaffolding, Staging, and Planking: Provide, set-up, and maintain all required hoists, scaffolds, and staging and planking, and perform all access related hoisting Work required to complete the Work of this section as indicated and specified.

.2 Protection:

.1 Cover or otherwise protect finished Work or other surfaces not being resurfaced.

.2 Erect and maintain protective tarps, enclosures and/or maskings to contain debris (such as dust or airborne particles resulting from surface preparation) generated during any and all Work activities. This includes, but is not limited to the use of dust/debris collection apparatus.

.3 Initial Inspection of Surfaces to be Coated:

.1 It is the responsibility of the Contractor to inspect and report unacceptable concrete substrate surface conditions to the Contract Administrator prior to the commencement of surface preparation activities. Unacceptable surface conditions are defined as the presence of cracked surfaces or concrete deteriorated to a depth of greater than 1-inch (25 mm) or otherwise unable to withstand surface preparation as specified herein.

3.3 Manufacturer's Recommendations

.1 Ensure straight even termination of resurfacing/topcoat materials on wall edges and flush with embedded steel.

.2 The Contractor must follow the minimum and maximum recoat limitation times and related temperature range restrictions between successive lifts for all products specified herein per Manufacturer's stated requirements.

.3 All equipment and procedures used for resurfacing system application shall be as recommended by the Manufacturer.

.4 Unless specified elsewhere herein, the Contractor shall comply with the Manufacturer's most recent written instructions with respect to the following:

.1 Mixing of all materials.

.2 Protection and handling of all materials.

.3 Recoat limitation and cure times.

.4 Minimum ambient and substrate temperatures, substrate's degree of dryness, relative humidity, and dew point of air.

.5 Application.

.6 Final curing.

.7 Use of proper application equipment.

.5 Where manufacturer's recommendations differ from the requirements stated herein, notify the Contract Administrator in advance of executing the Work.

.6 Curing of Resurfacing System:

.1 The applied resurfacing system shall be protected from damage during curing and shall be cured as recommended by the Manufacturer. Ambient conditions shall be controlled by the Contractor during curing to ensure the minimum air temperature and minimum relative humidity as required by the Manufacturer are maintained.

3.4 Surface Preparation

.1 All specified surface preparation shall be performed in accordance with the latest version of the SSPC, NACE and other standards referenced in this section.

.1 Concrete surfaces shall be abraded to produce a minimum surface profile of equal to 40 grit sandpaper with no loose concrete remaining. This preparation will be followed by vacuum cleaning to remove all dust, dirt or friable substances leaving clean, dust free surfaces for resurfacing.

.2 Oil and grease shall be removed before mechanical cleaning is started via an alkaline-based emulsifying detergent as recommended by the resurfacing material manufacturer. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded and free of contaminants that might interfere with the adhesion of the resurfacing materials.

.3 The air used for blast cleaning shall be free of oil and moisture to not cause contamination of the surfaces to be resurfaced.

.4 Clean cloths and clean fluids shall be used in solvent cleaning.

.5 Cleaning and resurfacing shall be scheduled so that dust and other contaminants from the cleaning process will not fall on wet, newly resurfaced areas.

.6 Prepare concrete joint and install sealant following resurfacing material installation.

.2 Initial Cleaning/Decontamination:

.1 All existing areas to be resurfaced shall be pressure washed with a 2500-5000 psi (17-34 MPa), steam cleaning, or other acceptable method in accordance with SSPC SP13/NACE 6 "Surface Cleaning Concrete for Coating". Use specified surface cleaner or approved alternate alkaline based detergent to remove all loose materials, acid constituents, grease, oil, and other contaminants (use potable water only, not plant water). Completely rinse off the surface to be coated.

.2 Verify that the pH of the cleaned concrete surfaces to be coated is within the range of 9 to 11. Application of coating materials outside this range will not be permitted without written approval from the Contract Administrator.

.3 Abrasive Blast Cleaning:

.1 Concrete shall be dry abrasive blast cleaned to satisfy SSPC SP13 “Abrading Concrete”, producing a surface with a roughened texture resembling coarse sandpaper. Concrete shall be free of crusts, soft or weak matter, loose aggregate, and all other contaminants. Sharp edges shall be rounded or trimmed by chipping, wire brushing, or any other acceptable method. At expansion joints, if any, filler compound shall be roughly flush with or lower than concrete surface.

.2 Used or spent blast abrasive shall not be reused on Work covered by this section.

.3 The compressed air used for blast cleaning will be filtered free of condensed water or oil. Moisture traps will be cleaned at least once every four (4) hours or more frequently as is appropriate.

.4 Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. Oil separators shall be cleaned at least once every four hours or more frequently as is appropriate.

.5 A paper blotter test shall be performed by the Contractor when requested by the Contract Administrator to determine if the air is sufficiently free of oil and moisture.

.6 Regulators, gauges, filters, and separators will be in good working order for all of the compressor air lines to blasting nozzles at all times during this Work.

.7 An air dryer or drying unit shall be installed which dries the compressed air prior to blast connections. This dryer shall be used and maintained for the duration of surface preparation Work.

.8 The quality, volume, and velocity of life support and ventilation air used during surface preparation shall be in accordance with applicable safety standards and to ensure adequate visibility and proper dissipation of volatiles without impacting the prepared surface or the health of the public or personnel working for the Contractor, Subcontractors, Contract Administrator, or anyone who may be affected by on-site maintenance coating Work activities.

.9 The abrasive blast nozzles used shall be the venturi or other high velocity type supplied with a minimum of 100 psig (0.69 MPa) air pressure and the necessary volume to obtain the required blast cleaning production rates and specified degree of cleanliness.

.10 The Contractor must provide adequate ventilation for airborne particulate evacuation and lighting (meeting all pertinent safety standards) to optimize visibility for both blast cleaning and observation of the substrate during surface preparation Work.

.11 All phases of surface preparation Work specified herein must be inspected by the Contract Administrator before the Contractor proceeds with the subsequent phase of surface preparation.

.12 If, between final surface preparation Work and coating application, contamination of the prepared and cleaned substrate occurs, or if the prepared steel’s appearance darkens or

changes colour, reblasting will be required until the specified degree of cleanliness is established.

.4 Resurfacing:

.1 Depending on project-specific needs for repair or resurfacing of concrete, Applicator shall select and use any or all of the products resurfacing materials as recommended by the manufacturer based on actual site conditions. Resurfacing products shall be mixed, applied, allowed to cure, and treated per manufacturer's recommendations, before they are coated.

.2 The minimum acceptable bonding of not less than 200 psi of tensile strength as tested under ASTM D 7234. Parging material is not considered to be part of the lining system but as repair material for the concrete.

3.5 Primer

.1 Preparation:

.1 Part A and B components shall be thoroughly agitated in their original separate containers for five (5) minutes to produce complete suspension, and then poured in the exact proportion that they are supplied into a dry, clean separate container. Components shall be blended together by agitating for an additional five (5) minutes, keeping mixing blade submerged to minimize whipping of air into material, until a uniform colour without streaks is achieved. Sides of container shall be scraped occasionally to ensure uniformity.

.2 Application:

.1 Materials shall be maintained between 16° to 24°C. Ambient temperatures shall be above 16°C. Substrate temperatures shall be above 16°C, and at least 3°C above dew point, and rising. Relative humidity shall not exceed 85%. Suspend application if conditions are not within recommended parameters, when snowing, raining or foggy, or when precipitation is imminent.

.2 Primer shall be applied at specified film thickness in a single application, using conventional airless spray equipment. Application by brush or roller shall not be permitted. Mixed primer that exceeds its pot-life shall not be used and shall be properly discarded. Applied primer shall be protected from contamination by dust, moisture, condensation, etc.

.3 Primer shall be top-coated with elastomeric polyurethane coating within the recoat window after it has been sprayed. If primer exceeds its re-coat time an additional coat of primer shall be applied at a nominal film thickness of 3 mils (0.08 mm). Before re-priming, surfaces shall be brush blasted to remove gloss, then vacuumed or solvent-wiped to dust-free condition, and all solvent allowed to dry.

3.6 Elastomeric Polyurethane Coating

.1 Part A shall be thoroughly mixed with drum mounted air-driven agitator for thirty (30) minutes immediately before each use. Agitation of Part B shall not be required.

.2 Coating shall be spray-applied by qualified technicians, using plural-component, high-pressure, airless spray equipment, approved by the manufacturer that automatically

proportions the Part A and B components, blends them via in-line static mixers and sprays the mixed coating material at a fluid pressure of 2,500 psi.

.3 Coating materials shall be maintained between 27° to 32°C. Ambient temperatures shall be between 4° to 49°C (40° and 120°F), and substrate temperatures shall be between 4° to 60°C (40° and 140°F) and at least 3°C (5°F) above dew point. Relative humidity shall not exceed 95%. Suspend application if conditions are not within above parameters, when snowing, raining or foggy, or when precipitation is imminent.

.4 Each coat shall be applied at specified film thickness in a single application, which may consist of several increments, accomplished by one or more passes of the spray gun, all applied within recommended recoat times to a specific area. High profile areas shall be coated using 4-way passes of the spray gun to ensure complete coverage. If necessary, film thickness may be increased as needed, until a holiday-free membrane is achieved. To minimize the creation of pinholes due to outgassing of air from porous concrete surfaces, coating shall be applied during a cooling trend in the concrete's surface temperature, in multiple increments of 20 to 30 mils (0.5 to 0.75 mm) per coat.

.5 Recoating / Transitions:

.1 Fresh coating may be sprayed over previously applied coating as long as undercoat remains wet or tacky to the touch, or has not exceeded 18 hours at 22°C (72°F) since application. Higher temperatures shorten the recoat window, and colder temperatures extend the recoat window.

.2 If recoat time is exceeded, undercoat shall be brush blasted to remove gloss, then vacuumed or solvent-wiped to dust-free condition, allowing all solvent to dry, before application of fresh coating.

.3 For transitions between coating sections applied on different days, a minimum 30 cm (12 inches) of the undercoat shall be brush blasted and prepared as described above, and fresh coating shall be feathered in at least 15 cm (6 inches). Avoid application to glossy surfaces, making sure there is plain evidence of brush blast beyond leading edge of fresh coating. Coating applied to improperly prepared surfaces shall be removed immediately.

.6 Leading Edges:

.1 During surface preparation, a saw-cut shall be made along each proposed leading edge of coating application as per Manufacturer's Recommendation. Saw-cuts shall be 12 mm to 25 mm deep x 3 mm to 6 mm wide. Sharp edges shall be rounded or trimmed, and saw-cut cavity shall be vacuumed to a dry, dust-free condition. Adjacent surfaces not to be coated shall be protected from overspray by taping-off in a neat manner.

.2 A brush shall be used to ensure that the primer is applied to the bottom and sides of the saw-cuts.

.3 A liberal amount of the elastomeric polyurethane coating material shall be spray-applied to saw-cut area, then pressed with trowel or putty knife into the saw-cut cavity and smoothed level, mechanically anchoring the leading edge to the substrate. After coating sets up, it shall be razor-cut to remove the protective tape, leaving a straight, neat leading edge.

.7 Expansion Joints:

.1 Geotextile fabrics shall be used to produce bond-breaking systems over all existing expansion joints.

.2 Pre-cut fabric strips, 15 cm (6 inches) in width, shall be centered lengthwise over each expansion joint, then firmly pressed and embedded, ”heat-set” side facing out, into a 1.00 mm (40 mil) base coat of elastomeric polyurethane coating while it remains in a semi-liquid state. Fabric shall be evenly pressed with a non-stick roller, squeegee or trowel to ensure that it is adhered flat against the basecoat in all locations. Over irregular surfaces, fabric shall be pressed by hand (use suitable protective gloves) to maximize contact with basecoat.

.3 A final coat shall be spray-applied directly to the exposed heat-set side of the embedded fabric at a dry film thickness of 2.00 mm (80 mils), concentrating application as needed along the fabric edges to produce complete coverage in all locations. Exposed fabric fibers or edges, or other discontinuities shall not be acceptable.

.8 Patching and Repairs:

.1 Surface Preparation:

.1 Repair area shall be decontaminated and deficient sections shall be removed until properly applied, firmly adhered coating materials are reached. Exposed surfaces shall be treated to satisfy applicable requirements. Coating material surrounding repair area shall be abraded to remove gloss, then solvent-wiped to dust-free condition and allowed to dry, before application of repair materials. Extent of abraded area shall depend on whether repair materials are spray or hand-applied, but in either case, no repair material shall be applied beyond abraded areas.

.2 Material and Application:

.1 A maximum 350 ml (12 fl. oz.) of Polibrid 705 coating material shall be hand-mixed in a 2A:1B volume ratio, or a Lifelast Durashield 310 JARS kit; then quickly and evenly applied by brush or putty knife, covering the repair area. Repair material shall not extend beyond surrounding abraded area. Any repair material applied to glossy or improperly prepared surfaces shall be removed immediately. Larger repairs may require spray-application.

3.7 Field Quality Control, Inspection and Testing

.1 Prior to commencement of the primer and coating, arrange for an inspection by the Manufacturer’s Representative to review the surface preparation. Manufacturer’s Representative to review and commencement of priming and commencement of elastomeric polyurethane coating. Allow for two (2) visits/site reports by the Manufacturer’s Representative. Manufacturer’s site visit costs to be included in the Work.

.2 Manufacturer’s Representative will confirm that surface preparation, priming and application coating is completed as per the manufacturer’s recommendations.

.3 Under the supervision of the Manufacturer’s Representative, ensure the following:

.1 Primer is mixed at proper volume ratio, and applied with no evidence of streaks or uneven colouring. Film thickness shall be verified by the Contractor by logging volumes of material applied to pre-measured areas. Inspection shall verify that applied primer is protected from contamination and topcoated within recommended recoat time.

.2 Coating is applied using spray-equipment approved by coatings manufacturer, monitoring its operation to verify that materials are applied with no evidence of streaks or uneven colouring. Film thickness shall be verified by the Contractor by logging volumes of material applied to pre-measured areas, using a machine-mounted, mechanical "stroke-counter" that records number of pump strokes applied.

.3 Recoating is accomplished within recommended recoat times. No fresh material is to be applied to glossy or improperly prepared surfaces; any material so applied is completely removed.

.4 The coating shall be visually inspected for blisters, poor adhesion, or improper cure. Deficiencies shall be marked and repaired per coating manufacturer's recommendations.

.5 Prior to placing the coating into service, provide satisfactory inspection, by a certified NACE, level III inspector that is familiar with application of coating on concrete surfaces.

.4 Perform the quality control procedures listed below in conjunction with the application requirements of this Section.

.1 Measure and record ambient air temperature once every two hours of each shift, using a thermometer and measure and record substrate temperature once every two hours using a surface thermometer.

.2 Measure and record relative humidity every two (2) hours of each shift using a sling psychrometer in accordance with ASTM E337.

.5 Holiday Detection:

.1 Engage the services of a third party independent testing agency approved by the Contract Administrator to carry out holiday detection of the applied coating.

.2 The coating shall be inspected per ASTM D-4787 "Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates", using high-voltage spark testing equipment with variable settings. Test voltage shall be set at an initial 4,000 volts per mm (100 volts per mil) of specified film thickness, and then increased as needed to compensate for relative conductivity of the concrete substrate by spark testing an induced holiday at furthest extension of test probe from grounding location. Once test voltage is determined, it shall be used throughout that area and re-determined again every time a new ground is made. Detected holidays shall be marked and repaired per coating manufacturer's recommendations.

END OF SECTION

WALL AND DOOR PROTECTION

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Crash rail (CR.1).

.2 Rubber wall rail (CR.2).

.3 Door kickplates (DK).

.4 Handrail (HR).

.5 Door jamb frame guards (JG).

.2 Related Requirements:

.1 Section 06 10 00 - Rough Carpentry, plywood backing.

.2 Section 09 91 00 - Painting, priming substrates prior to application of wall and door protection.

1.2 Administrative Requirements

.1 Co-ordinate with appropriate trades responsible for installation of continuous backing behind gypsum board as required to provide rigidity and strength for wall protection.

1.3 Action and Informational Submittals

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

.2 Product Data: Submit manufacturer's printed product literature, specifications and data sheets.

.3 Shop Drawings: Indicate, by large scale details, materials, finishes, dimensions, anchorage and assembly.

.4 Samples: Submit duplicate 300 by 200 mm or 300 mm long samples of profiles and colours for each item of wall and door protection.

1.4 Closeout Submittals

.1 Maintenance Data: For wall and door protection to include in operation and maintenance manuals.

1.5 Quality Assurance

.1 Installer: specialty contractor normally engaged in this type of work and shall have experience in the installation of these types of materials.

.2 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 Waste Management and Disposal

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

1.7 Environmental Conditions

.1 Maintain constant 21°C air temperature and maximum for seventy-two (72) hours before, during and forty-eight (48) hours after installation.

2. PRODUCTS

2.1 Materials

.1 General:

.1 Like materials to be from single manufacturer, each material to be from single dye-lot or production run, unless otherwise stated.

.2 Provide applicable accessories including but not limited to top and bottom caps, and vertical joint covers.

.2 Crash Rail (CR.1): Impact resistant, continuous surface mounted resilient crash rail assembly with continuous aluminum retainer, and 100 mm high bullnose shape snap-on PETG cover, complete with rubber mounting cushion. Allow for one colour selected by the City from manufacturer's complete colour range.

.1 Acceptable Products: C/S Group BG-10N.

.3 Rubber Wall Rail (CR.2): Heavy-duty extruded vinyl double bulb bumper with urethane end caps. Allow for one colour selected by the City from manufacturer's complete colour range.

.1 Acceptable Products: Pawling MD-2 Marine and Industrial Fender; Wall Guard WGDC 2235.1

.4 Door Kickplates (DK): rigid PETG, 1.52mm thick, 600 mm high, and length to suit door, complete with beveled edges and factory applied, double face strippable adhesive backing.

.1 Acceptable Products: C/S Group Acrovyn 4000 Kick Plates, InPro Corp EnviroGT G2 Series Kickplates.

.5 Handrail (HR): 38 mm dia. continuous aluminum retainer with snap-on PETG cover, complete with returns and end caps, and mounting brackets at maximum 800 mm o.c.

.1 Acceptable Products: C/S Group HR-6CN with 50 mm gap between edge of handrail and adjacent wall.

.6 Door Frame Jamb Guards (JG): Surface-mounted over two lead-in edges of door frame; 76 mm wings, 1.98 mm thick PETG high-impact snap-on cover, mechanically fastened continuous extruded aluminum alloy snap-in retainer. Provide manufacturer's matching top closure caps. Allow for [one] colour selected by the City from manufacturer's complete colour range. Length indicated.

.1 Acceptable Products: C/S Group D1 DFPN; InPro Corp EnviroGT G2-1700 High Impact Door Frame Guard.

2.2 Accessories

.1 Fasteners: self-tapping stainless steel.

.2 Adhesive: water-resistant type as recommended by manufacturer for substrate. Maximum VOC content 70 g/L (less water) to SCAQMD Rule 1168.

2.3 Finishes

.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

.1 Remove tool and die marks and stretch lines, or blend into finish.

.2 Grind and polish surfaces to produce uniform finish, free of cross scratches.

.3 Run grain of directional finishes with long dimension of each piece.

.4 When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

.2 Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

.3 Aluminum:

.1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.

.2 As fabricated or mill finish.

.3 Appearance and properties of anodized finishes designated by the Aluminum Association as Architectural Class 1, Architectural Class 2, and Protective and Decorative.

3. EXECUTION

3.1 Examination

.1 Before installation verify surfaces are suitable for installation.

.1 Notify the City of conditions detrimental to proper completion of installation.

.2 Start of Work implies acceptance of conditions.

3.2 Manufacturer's Instructions

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.3 Installation

.1 Co-ordinate with appropriate trades responsible for installation of continuous blocking behind gypsum board substrate.

.2 Install units on solid backing and erect with materials and components straight, tight and in alignment.

.3 Install wall protection in strict accordance with manufacturer’s instructions and reviewed Shop Drawings.

.4 Crash Rail (CR.1):

.1 Install straight and level to tolerance of 1:1000.

.2 Mechanically fasten continuous aluminum retainer through rubber cushion to solid backing with manufacturer’s recommended fasteners, at 400 mm o.c. maximum.

.3 Install snap-on covers over retainers. Use full length pieces wherever possible to minimize joints. Where joints are required, make tight butt joints, without gaps. Offset joints in covers with splice joints in retainers minimum 100 mm. Where joints in retainers are required, splice retainer within 100 mm of bracket.

.4 Install wall returns and corner pieces with concealed mechanical fasteners.

.5 Where doors open against adjacent side walls, terminate bumper railing 100 mm from leading edge of door when door is in open position.

.5 Rubber Wall Rail (CR.2):

.1 Install straight and level to tolerance of 1:1000.

.2 Mechanically fasten to solid backing with manufacturer’s recommended fasteners, at 400 mm o.c. maximum.

.3 Install end caps.

.4 Where doors open against adjacent side walls, terminate wall rail 100 mm from leading edge of door when door is in open position.

.6 Door Kickplates (DK): Install using double-sided tape. Apply pressure with roller over entire surface. No joints in kickplate permitted.

.7 Handrail (HR):

.1 Install straight and level to tolerance of 1:1000.

.2 Mechanically fasten mounting brackets to solid backing with manufacturer's recommended fasteners, at 800 mm o.c. maximum.

.3 Install handrail onto bracket with one concealed mechanical fastener per bracket.

.4 Install wall returns and corner pieces with concealed mechanical fasteners.

.5 Install snap-on covers over retainers. Use full length pieces wherever possible to minimize joints. Where joints are required, make tight butt joints, without gaps. Offset joints in covers with splice joints in retainers minimum 50 mm. Where joints in retainers are required, splice retainer within 75 mm of bracket.

.6 Provide mounting brackets within 75 mm from inside and outside corners, and 150 mm from end returns.

.7 Where doors open against adjacent side walls, terminate handrails 100 mm from leading edge of door when door is in open position.

.8 Door Jamb Frame Guards (JG):

.1 Mechanically fasten aluminum retainers to substrate at maximum 450 mm o.c.

.2 Mount with bottom of door jamb frame guard at bottom of frame, and top of door jamb frame guard at 600 mm AFF unless indicated otherwise.

.3 Install snap-on covers over retainers. Use full length pieces. Provide top and bottom closures.

3.4 Cleaning

.1 Perform cleaning after installation to remove excel adhesive, and construction and accumulated environmental dirt.

.2 Clean surfaces after installation using manufacturer's recommended cleaning procedures.

.3 Do not use Xylene based products to clean vinyl products.

.4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Portable fire extinguishers.

.2 Wall brackets.

.3 Fire extinguisher cabinets.

.2 Related Requirements:

.1 Section 09 91 00 - Painting, for field painting of fire extinguisher cabinets.

1.2 Administrative Requirements

.1 Coordination:

.1 Coordinate blocking for fire extinguisher brackets as / where required.

.2 Coordinate sizes and locations of fire protection extinguisher with wall depths.

.3 Coordinate shop painting of fire extinguisher cabinets minimum two (2) weeks before installation.

1.3 Action and Informational Submittals

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

.2 Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components, and finishes for fire extinguisher cabinets.

.1 Extinguishers and Mounting Brackets: Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

.2 Fire Extinguisher Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

.3 Shop Drawings: For fire extinguisher cabinets. Include plans, elevations, sections, details, and attachments to other work. Coordinate fire extinguisher cabinets with fire extinguishers to ensure proper fit and function.

1.4 Closeout Submittals

.1 Maintenance Data: For fire protection specialties to include in operation and maintenance manuals.

1.5 Quality Assurance

.1 Fire Extinguishers:

.1 Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

.2 ULC and NFPA Compliance: Fabricate and label fire extinguishers to comply with CAN/ULC S503, CAN/ULC S504, and CAN/ULC S507 NFPA 10.

1.6 Delivery, Storage and Handling

.1 Deliver products in original wrappings or containers with manufacturers' labels intact.

.2 Do not deliver fire extinguishers to site until spaces to receive them are clean, dry, and ready for locker installation.

.3 Waste Management:

.1 Deposit packaging materials in appropriate container on Site for recycling or reuse.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

2. PRODUCTS

2.1 Portable, Hand-Carried Fire Extinguishers

.1 General:

.1 Instruction Labels: Include pictorial marking system complying with NFPA 10, Annex B.

.2 Multi-Purpose Pressurized Dry Chemical: to CAN/ULC-S504.

.1 Description: Multi-purpose mono-ammonium phosphate, powder type, heavy duty steel cylinder, baked enamel finish, squeeze grip handle with positive on/off valve, hose and nozzle, ULC labelled.

.2 Capacity and Rating: 6-A:80-B:C, 4.5-kg.

.3 Classification: A, B and C fires.

.4 Acceptable Products: Strike First ABC-100WWD; Amerex 6A: 80BC; Sylprotec ULC 6A 80BC.

.3 Carbon Dioxide: to CAN/ULC-S503.

.1 Description: Carbon dioxide charged heavy duty steel cylinder, baked enamel finish, insulated positive on/off squeeze grip handle, impact resistance discharge horn, ULC labelled.

.2 Capacity: 4.5 kg.

.3 Capacity Rating: 10BC.

.4 Classification: Class B and C fires.

.5 Acceptable Products: Badger B10V-1, Strike First CO2-100WW, Larsen's CD10.

.4 Pressurized Water Extinguisher: to CAN/ULC S507.

.1 Stored pressure type, squeeze-grip operated, stainless steel construction, labeled by Underwriters' Laboratories of Canada, with wall brackets, 9L (2.4 gal) size, ULC class 2A.

.2 Acceptable Products: Badger WP-61, Strike First WBDL-PW250, Larsen's PW 2 ½.

2.2 Fire Extinguisher Cabinets

.1 Cabinet Type: Suitable for fire extinguisher.

.2 Cabinet Construction: to maintain fire resistive rating of construction in which they occur.

.3 Cabinet Material: Steel sheet.

.4 Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

.1 Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

.5 Cabinet Trim Material: Same material and finish as door.

.6 Door Material: Steel sheet.

.7 Door Style: Fully glazed panel with frame.

.8 Door Glazing: single piece projecting panel, injection moulded, clear, shatterproof.

.9 Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

.1 Provide recessed door pull and friction latch.

.2 Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

.10 Accessories:

.1 Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

.2 Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

.1 Identify fire extinguisher in fire protection cabinet with the words “FIRE EXTINGUISHER” applied to cabinet door. Letter colour: Red.

.11 Finishes: Factory primed for field painting.

.12 Basis of Design: National Fire Equipment.

2.3 Extinguisher Brackets

.1 Mounting Brackets: galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguisher, with plated or baked-enamel finish.

2.4 Fabrication

.1 Fire Extinguisher Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

.1 Weld joints and grind smooth.

.2 Provide factory-drilled mounting holes.

.2 Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

.3 Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 General Finish Requirements

.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

.2 Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

.3 Finish fire protection cabinets after assembly.

2.6 Steel Finishes

.1 Surface Preparation: Remove mill scale and rust, if present, from uncoated steel.

.2 Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

3. EXECUTION

3.1 Examination

.1 Examine walls and partitions for suitable blocking.

.2 Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

.1 Prepare recesses for recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 Installation

.1 General: Install fire protection cabinets and mounting brackets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:

.1 Fire Protection Cabinets: 1372 mm above finished floor to top of cabinet.

.2 Wall-mounted Fire Extinguishers: in accordance with NFPA 10. Mount at consistent height based on weight.

.1 Fire extinguishers less than 18.14 kg: top of fire extinguisher at 1500 mm AFF.

.2 Fire extinguishers more than 18.14 kg: top of fire extinguisher at 1070 mm AFF.

.2 Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

.1 Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semi-recessed fire protection cabinets.

.2 Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

.3 Identification:

.1 Apply decals at locations indicated or as directed.

.2 Attach bilingual tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

3.4 Adjusting and Cleaning

.1 Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

.2 Adjust fire protection cabinet doors to operate easily without binding.

.3 On completion of fire extinguisher cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

.4 Touch up marred finishes, or replace fire extinguisher cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire extinguisher cabinet and mounting bracket manufacturers.

.5 Replace fire extinguisher cabinets that have been damaged or have deteriorated beyond successful repair by finish touch-up or similar minor repair procedures.

END OF SECTION

1. GENERAL

1.1 Related Requirements

.1 Section 09 91 00 - Painting.

.2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 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 all fixtures and fittings and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on Drawings:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.2 Shop Drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

.3 In addition to the transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify the section and paragraph number.

1.3 Closeout Submittals

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data together with test certificates and records for incorporation into the manual.

.1 Operation and maintenance manual approved by, and final copies deposited with, the Contract Administrator before final inspection.

.2 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and components.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.3 Maintenance data to include:

.1 Servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required, and task time.

.4 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Approvals:

.1 Submit two (2) copies of draft Operation and Maintenance Manual to the Contract Administrator for approval. Submission of individual data will not be accepted unless directed by The Contract Administrator.

.2 Make changes as required and re-submit as directed by the Contract Administrator.

.6 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.7 Site records:

.1 The Contract Administrator will provide one (1) set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.8 As-built Drawings:

.1 Prior to the start of Testing, Adjusting and Balancing for HVAC, finalize production of As-built Drawings.

.2 Identify each drawing in lower right-hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to the Contract Administrator for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for Plumbing using As-built Drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.9 Submit copies of As-built Drawings for inclusion in the final TAB report.

1.4 Maintenance Material Submittals

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish spare parts as follows:

.1 One (1) set of packing for each pump.

.2 One (1) casing joint gasket for each size pump.

.3 One (1) glass for each gauge glass.

.3 Provide one (1) set of special tools required to service equipment as recommended by manufacturers.

.4 Furnish one (1) commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.5 Delivery, Storage and Handling

.1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the Site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off of the ground in a dry location and in accordance with manufacturer's recommendations in a clean, dry, well-ventilated area.

.2 Store and protect materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Painting Repairs and Restoration

.1 Do painting in accordance with Section 09 91 00 - Painting.

.2 Prime and touch-up marred finished paintwork to match original.

.3 Restore to new condition, finishes which have been damaged.

3.2 System Cleaning

.1 Clean interior and exterior of all systems including strainers.

3.3 Field Quality Control

.1 Site Tests: conduct the following tests in accordance with Section 01 45 00 - Quality Control and submit a report as described in Part 1 - Action and Informational Submittals.

.1 Flow Testing.

.2 Pressure Testing.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Part 1 - Action and Informational Submittals.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.4 Demonstration

.1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to the following equipment and systems:

.1 None.

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, troubleshooting, and servicing of all systems and equipment during regular work hours, prior to acceptance.

.4 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.

.5 Instruction duration time requirements as specified in appropriate sections.

.6 The Contract Administrator will record these demonstrations on videotape for future reference.

3.5 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

3.6 Protection

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

PLUMBING SPECIALTIES AND ACCESSORIES

1. GENERAL

1.1 Related Requirements

.1 Section 09 91 00 – Painting.

.2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 Reference Standards

.1 American National Standards Institute (ANSI):

.1 ANSI Z358.1, American National Standard for Emergency Eyewash and Shower Equipment.

.2 American Society of Sanitary Engineers (ASSE):

.1 ASSE 1071, Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment

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 plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two (2) copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Shop Drawings:

.1 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions construction and assembly details and accessories.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

1.4 Closeout Submittals

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.

.1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Emergency Eyewash

.1 Eye/Face Wash.

.2 Wall mounted, brushed stainless steel bowl, chrome plated diffusers with stainless steel mesh, with push plate operation.

.3 Minimum flow rate 12 l/min.

.4 Basis of Design:

.1 Hughes.

.2 Guardian.

.3 Bradley.

.4 Or acceptable equal.

2.2 Thermostatic Valve

.1 ASSE 1071 certified.

.2 Lead-free DZR brass body with corrosion-resistant and lead-free internal components, paraffin actuator.

.3 Internal cold water bypass.

.4 Factory set to 29°C.

.5 Basis of Design:

.1 Hughes.

.2 Guardian.

.3 Bradley.

.4 Or acceptable equal.

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 data sheet.

3.2 Installation

.1 Install in accordance with National Plumbing Code of Canada (NPC) with Manitoba Amendments and local authority having jurisdiction.

.2 Install in accordance with manufacturer's instructions and as specified.

3.3 Start-Up

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified herein.

.2 Timing: start-up only after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.3 Provide continuous supervision during start-up.

3.4 Testing and Adjusting

.1 General:

.1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified.

.2 Timing:

.1 After start-up deficiencies rectified.

.2 After certificate of completion has been issued by authority having jurisdiction.

.3 Application tolerances:

.1 Pressure at fixtures: +/- 70 kPa.

.2 Flow rate at fixtures: +/- 20%.

.4 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.

.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

3.5 Closeout Activities

.1 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning Requirements: reports, supplemented as specified.

.2 Training: provide training in accordance with Section 01 91 13 - General Commissioning Requirements: Training of O&M Personnel, supplemented as specified.

3.6 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

3.7 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.

END OF SECTION

1. GENERAL

1.1 Related Requirements

.1 Section 22 05 00 - Common Work Results for Plumbing.

.2 Section 22 05 15 - Plumbing Specialties and Accessories.

.3 Section 23 07 19 - HVAC Piping Insulation.

1.2 Reference Standards

.1 American Society of Mechanical Engineers International (ASME):

.1 ANSI/ASME B16.15, Cast Cooper Alloy Threaded Fittings, Classes 125 and 250.

.2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.

.2 ASTM International (ASTM):

.1 ASTM B88M, Standard Specification for Seamless Copper Water Tube (Metric).

.3 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S101, Fire Endurance Tests of Buildings Construction and Materials.

.2 CAN/ULC S102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

.3 CAN/ULC S115, Standard Method of Fire Tests of Firestop.

.4 Department of Justice Canada (Jus):

.1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

.6 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):

.1 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

.7 National Research Council (NRC):

.1 National Plumbing Code of Canada (NPC) with Manitoba Amendments.

.8 Transport Canada (TC):

.1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.3 Action and Informational Submittals

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, 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 78 00 - Closeout Submittals.

1.4 Delivery, Storage and Handling

.1 Deliver material to job Site in original non-broken factory packaging.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

2. PRODUCTS

2.1 Piping

.1 Domestic hot, cold and recirculation systems, within building.

.1 Above ground:

.1 Copper tube, hard drawn, type K: to ASTM B88M.

.2 Buried or embedded:

.1 Copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.

2.2 Fittings

.1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI/ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

2.3 Joints

.1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.

.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.3 Solder: 95/5 tin copper alloy.

.4 Teflon tape: for threaded joints.

.5 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner. NPS 1 ½ and smaller: PEX fittings to CSA B137.5.

2.4 Ball Valves

.1 NPS 2 and under, screwed:

.1 Class 150.

.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle colour-coded for commodity.

.2 NPS 2 and under, soldered:

.1 To ANSI/ASME B16.18, Class 150.

.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle colour-coded for commodity.

3. EXECUTION

3.1 Application

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Installation

.1 Install in accordance with NPC with Manitoba amendments and local authority having jurisdiction.

.2 Install pipework in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework, supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards.

.4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.

.5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.6 Buried tubing.

.7 Valves:

.1 Isolate equipment, fixtures and branches with ball valves.

.2 Balance recirculation system using lockshield globe valves. Mark settings and record on As-built Drawings on completion.

3.3 Pressure Tests

.1 Test pressure: greater of one (1) time maximum system operating pressure or 860 kPa.

3.4 Flushing and Cleaning

.1 Flush entire system for eight (8) hours. Ensure outlets flushed for two (2) hours. Let stand for twenty-four (24) hours, then draw one (1) sample off longest run. Submit to testing laboratory to verify that system is clean to Provincial potable water guidelines. Let system flush for additional two (2) hours, then draw off another sample for testing.

3.5 Pre-Start-Up Inspections

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

3.6 Disinfection

.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.

.2 Upon completion, provide laboratory test reports on water quality for Contract Administrator approval.

3.7 Start-Up

.1 Timing: start up after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.

.3 Bring HWS storage tank up to design temperature slowly.

.4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.

.5 Check control, limit, safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.8 Performance Verification

.1 Scheduling:

.1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.

.2 Procedures:

.1 Verify that flow rate and pressure meet Design Criteria.

.2 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

.4 Sterilize HWS and HWC systems for Legionella control.

.5 Verify performance of temperature controls.

.6 Verify compliance with safety and health requirements.

.7 Check for proper operation of water hammer arrestors. Run [one] outlet for ten (10) seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

.3 Reports:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.

.2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.9 Operation Requirements

.1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

3.10 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

SANITARY WASTE AND VENT PIPING - PLASTIC

1. GENERAL

1.1 Related Requirements

.1 Section 07 92 00 - Joint Sealants.

.2 Section 22 05 00 - Common Work Results for Plumbing.

.3 Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

1.2 Reference Standards

.1 ASTM International (ASTM):

.1 ASTM D2235, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

.2 ASTM D2564, Standard Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 CSA Group (CSA):

.1 CAN/CSA-Series B1800, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.

.3 Green Seal Environmental Standards (GSES):

.1 Standard GS-36, Commercial Adhesives.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

.5 National Research Council Canada (NRC):

.1 National Plumbing Code of Canada (NPC).

.6 South Coast Air Quality Management District (SCAQMD), California State:

.1 SCAQMD Rule 1168, Adhesive and Sealant Applications.

1.3 Action and Informational Submittals

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two (2) copies WHMIS SDS - Safety Data Sheets.

1.4 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the Site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Material

.1 Adhesives and Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.1 Maximum VOC limit 70 g/L to SCAQMD Rule 1168 or GSES GS-36.

2.2 Piping and Fittings

.1 For buried and/or above-ground DWV piping to:

.1 CAN/CSA B1800.

2.3 Joints

.1 Solvent weld for PVC: to ASTM D2564.

.2 Solvent weld for ABS: to ASTM D2235.

3. EXECUTION

3.1 Application

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Installation

.1 In accordance with Section 23 05 15 - Common installation requirements for HVAC pipework.

.2 Install in accordance with National Plumbing Code with Manitoba Amendments and local authority having jurisdiction.

3.3 Testing

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 Performance Verification

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage:

.1 Verify domes are secure.

.2 Ensure weirs are correctly sized and installed correctly.

.3 Verify provisions for movement of roof system.

.4 Ensure fixtures are properly anchored, connected to system and effectively vented.

.5 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

1. GENERAL

1.1 Related Requirements

.1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.2 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

.3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

.4 Section 23 31 13.01 - Metal Ducts – Low Pressure to 500 Pa

.5 Section 23 33 00 - Air Duct Accessories

.6 Section 23 33 15 - Dampers – Operating

.7 Section 23 34 00 - HVAC Fans

.8 Section 23 37 20 - Louvres, Intakes and Vents.

1.2 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 and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on Drawings:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.2 Shop Drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

.3 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.3 Closeout Submittals

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

.1 Operation and maintenance manual approved by, and final copies deposited with, Contract Administrator before final inspection.

.2 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.3 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.4 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Approvals:

.1 Submit two (2) copies of draft Operation and Maintenance Manual to Contract Administrator for approval. Submission of individual data will not be accepted unless directed by Contract Administrator.

.2 Make changes as required and re-submit as directed by Contract Administrator.

.6 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.7 Site records:

.1 Contract Administrator will provide one (1) set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.8 As-Built Drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of As-Built Drawings.

.2 Identify each Drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Contract Administrator for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using As-Built Drawings.

.5 Submit completed reproducible As-Built Drawings with Operating and Maintenance Manuals.

.9 Submit copies of As-Built Drawings for inclusion in final TAB report.

1.4 Maintenance Material Submittals

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish spare parts as follows:

.1 One (1) set of packing for each pump.

.2 One (1) casing joint gasket for each size pump.

.3 One (1) head gasket set for each heat exchanger.

.4 One (1) glass for each gauge glass.

.5 One (1) filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.3 Provide one (1) set of special tools required to service equipment as recommended by manufacturers.

.4 Furnish one (1) commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the Site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for 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 Painting Repairs and Restoration

.1 Do painting in accordance with Section 09 91 00 - Painting.

.2 Prime and touch-up marred finished paintwork to match original.

.3 Restore to new condition, finishes which have been damaged.

3.3 System Cleaning

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.4 Field Quality Control

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic Site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5 Demonstration

.1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.4 Use operation and maintenance manual, As-Built Drawings, and audio visual aids as part of instruction materials.

.5 Instruction duration time requirements as specified in appropriate sections.

.6 Contract Administrator will record these demonstrations on video tape for future reference.

3.6 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

3.7 Protection

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Electrical motors, drives and guards for mechanical equipment and systems.

.2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.

1.2 Reference Standards

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):

.1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

1.3 Action and Informational Submittals

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.

.3 Quality Control: 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 Instructions: submit manufacturer's installation instructions.

.1 Contract Administrator will make available one (1) copy of systems supplier's installation instructions.

.4 Closeout Submittals:

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 Quality Assurance

.1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.

1.5 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

2. PRODUCTS

2.1 General

.1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

2.2 Motors

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, 600 V, unless otherwise indicated.

2.3 Temporary Motors

.1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Contract Administrator for temporary use. Work will only be accepted when specified motor is installed.

2.4 Belt Drives

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

.3 For motors under 7.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.5 Drive Guards

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;

.1 Expanded metal screen welded to steel frame.

.2 Minimum 1.2 mm thick sheet metal tops and bottoms.

.3 38 mm dia holes on both shaft centres for insertion of tachometer.

.4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

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 datasheet.

3.2 Installation

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

3.3 Field Quality Control

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in Part 1 - Submittals.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Part 1 - Submittals.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule Site visits, to review Work, as directed in Part 1 - Quality Assurance.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1. GENERAL

1.1 Related Requirements

.1 Section 07 84 00 - Fire Stopping

.2 Section 07 92 00 - Joint Sealants

.3 Section 22 11 16 - Domestic Water Piping

.4 Section 22 13 16.16 - Sanitary Waste and Vent Piping.

1.2 Reference Standards

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

.2 National Research Council Canada (NRC):

.1 National Fire Code of Canada (NFC).

1.3 Action and Informational 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 for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 Quality Assurance

.1 Sustainability Standards Certification:

.1 Low-Emitting Materials: provide listing of sealants and coatings used in building, comply with VOC and chemical component limits or restriction requirements.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the Site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Material

.1 Paint: zinc-rich to CAN/CGSB-1.181.

.1 Primers, Paints, and Coating: apply in accordance with manufacturer's recommendations for surface conditions.

.2 Primer: maximum VOC limit 250 g/L.

.3 Paints: maximum VOC limit 150 g/L.

.2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.3 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping.

3. EXECUTION

3.1 Application

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Connections To Equipment

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 Clearances

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

3.4 Drains

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain.

.1 Discharge to be visible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 Air Vents

.1 Install manual air vents to CAN/CSA B139 at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.6 Dielectric Couplings

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

3.7 Pipework Installation

.1 Install pipework to CAN/CSA B139.

.2 Screwed fittings jointed with Teflon tape.

.3 Protect openings against entry of foreign material.

.4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.5 Assemble piping using fittings manufactured to ANSI standards.

.6 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.10 Install, except where indicated, to permit separate thermal insulation of each pipe.

.11 Group piping wherever possible and as indicated.

.12 Ream pipes, remove scale and other foreign material before assembly.

.13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.14 Provide for thermal expansion as indicated.

.15 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless indicated.

.4 Valves accessible for maintenance without removing adjacent piping.

.5 Install globe valves in bypass around control valves.

.6 Use ball valves at branch take-offs for isolating purposes except where specified.

.16 Check Valves:

.1 Install silent check valves in vertical pipes with downward flow and as indicated.

3.8 Sleeves

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

.2 Other floors: terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere:

.1 Provide space for fire stopping.

.2 Maintain the fire-resistance rating integrity of the fire separation.

.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.9 Escutcheons

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws.

.1 Chrome or nickel plated brass or type 302 stainless steel..

.3 Sizes: outside diameter to cover opening or sleeve.

.1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 Preparation for Fire Stopping

.1 Coordinate the installation of fire stopping around pipes, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.

.2 Pipes subject to movement: conform to fire stop system design listing to ensure pipe movement without damaging fire stopping material or installation.

.3 Insulated pipes: ensure integrity of insulation and vapour barriers.

3.11 Pressure Testing of Equipment and Pipework

.1 Advise Contract Administrator in writing forty-eight (48) hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.

.3 Maintain specified test pressure without loss for four (4) hours minimum unless specified for longer period of time in relevant mechanical sections.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Contract Administrator.

.6 Pay costs for repairs or replacement, retesting, and making good. Contract Administrator to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Contract Administrator.

3.12 Existing Systems

.1 Connect into existing piping systems at times approved by Contract Administrator.

.2 Request written approval by Contract Administrator ten (10) days minimum, prior to commencement of Work.

.3 Be responsible for damage to existing plant by this Work.

3.13 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

1. GENERAL

1.1 Related Requirements

.1 Section 23 05 00 - Common Work Results for HVAC..

.2 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

.3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.4 Section 23 31 13.01 - Metal Ducts – Low Pressure to 500 Pa.

.5 Section 23 33 00 - Air Duct Accessories.

.6 Section 23 33 15 - Dampers – Operating.

.7 Section 23 34 00 - HVAC Fans.

.8 Section 23 37 20 - Louvres, Intakes and Vents.

1.2 Reference Standards

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B31.1, Power Piping.

.2 ASTM International (ASTM):

.1 ASTM A125, Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A30, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):

.1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.

.4 National Research Council Canada (NRC):

.1 National Plumbing Code of Canada (NPC).

.5 Underwriter's Laboratories of Canada (ULC).

1.3 Action and Informational Submittals

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit Shop Drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.4 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

.1 Contract Administrator will make available one (1) copy of systems supplier's installation instructions.

1.4 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the Site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 System Description

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

.2 Performance Requirements:

.1 Design supports, platforms, catwalks, hangers to withstand seismic events as specified Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.2 General

.1 Fabricate hangers, supports and sway braces in accordance with MSS SP58. ANSI B31.1; and

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 Pipe Hangers

.1 Finishes:

.1 Pipe hangers and supports: galvanized, painted with zinc-rich paint after manufacture.

.2 Use hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are epoxy coated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 9 mm UL listed.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP58 and MSS-SP69.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP69.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.

.4 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge-shaped body with knockout protector plate UL listed to MSS SP69.

.5 Hanger rods: threaded rod material to MSS SP58:

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.3 Do not use 22 mm or 28 mm rod.

.6 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: carbon steel galvanized.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.7 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for riveting to insulation shields.

.8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.9 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion epoxy coated.

.10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.4 Insulation Protection Shields

.1 Insulated cold piping:

.1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.5 Equipment Supports

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.6 Equipment Anchor Bolts and Templates

.1 Provide templates to ensure accurate location of anchor bolts.

2.7 Other Equipment Supports

.1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.

.2 Submit structural calculations with Shop Drawings.

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 datasheet.

3.2 Installation

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to industry standards.

.3 Steel pipes: install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 Vertical movement of pipework is 13 mm or more,

.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.

.2 Variation in supporting effect does not exceed 25 % of total load.

3.3 Hanger Spacing

.1 Plumbing piping: to National Plumbing Code of Canada (NPC) with Manitoba Amendments and to the satisfaction of the authority having jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.6 Within 300 mm of each elbow.

.7 Pipework greater than NPS 12: to MSS SP69.

3.4 Hanger Installation

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 Horizontal Movement

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 Final Adjustment

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

3.7 Field Quality Control

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 Reference Standards

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

.2 National Research Council Canada (NRC):

.1 National Building Code of Canada (NBC).

1.3 Action and Informational Submittals

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

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two]copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedure.

.2 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

.1 Shop Drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Provide separate Shop Drawings for each isolated system complete with performance and product data.

.3 Provide detailed drawings of seismic control measures for equipment and piping.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.1 Contract Administrator will make available one (1) copy of systems supplier's installation instructions.

.3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 Quality Assurance

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the Site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 General

.1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 Elastomeric Pads

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 Elastomeric Mounts

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 Springs

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Cadmium plate for outdoor installations.

.4 Colour code springs.

2.5 Spring Mount

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

2.6 Hangers

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

2.7 Acoustic Barriers for Anchors and Guides

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.8 Horizontal Thrust Restraint

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

2.9 Structural Bases

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm minimum.

2.10 Inertia Base

.1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gussetted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.

.2 Pump bases: "T" shaped, where applicable, to provide support for elbows.

.3 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

2.11 Roof Curb Isolation Rails

.1 General: complete factory assembled without need for sub-base.

.2 Lower member: continuous rectangular steel tube or extruded aluminum channel.

.3 Upper member: continuous rectangular steel tube or extruded aluminum channel to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6 mm thick to resist wind and seismic forces.

.4 Springs: steel, adjustable, removable, selected for 25 mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.

.5 High frequency isolation: 6 mm minimum thick continuous gasket on top and bottom of complete assembly or pads on top and bottom of each spring. Material: closed cell neoprene.

.6 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: neoprene.

.7 Hardware: cadmium plated or galvanized.

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 datasheet.

3.2 Installation

.1 Seismic control measures to meet requirements of NBC.

.2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

.2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.5 Where isolation is bolted to floor use vibration isolation rubber washers.

.6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 Field Quality Control

.1 Manufacturer's Field Services:

.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.

.2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:

.1 After delivery and storage of Products.

.2 After preparatory work is complete but before installation commences.

.3 Twice during the installation, at 25% and 60% completion stages.

.4 Upon completion of installation.

.3 Submit manufacturer's reports to Contract Administrator within three (3) days of manufacturer representative's review.

.4 Make adjustments and corrections in accordance with written report.

.2 Inspection and Certification:

.1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.2 Provide Contract Administrator with notice forty-eight (48) hours in advance of commencement of tests.

.3 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).

.4 Submit complete report of test results including sound curves.

3.4 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

.2 Related Requirements:

.1 Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

.2 Section 23 33 15 - Dampers – Operating.

.3 Section 23 34 00 - HVAC Fans.

1.2 Reference Standards

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears.

.3 The City of Winnipeg:

.1 Water & Waste Department Identification Standard.
https://winnipeg.ca/waterandwaste/pdfs/dept/IdentificationStandard.pdf

.4 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-24.3, Identification of Piping Systems.

1.3 Action and Informational Submittals

.1 Product Data:

.2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.3 Product data to include paint colour chips, other products specified in this section.

.4 Samples:

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

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 Quality Assurance

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the Site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Manufacturer's Equipment Nameplates

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 System Nameplates

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background.

.2 Construction:

.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: use size # 5.

.2 Equipment: use size # 7.

2.3 Existing Identification Systems

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this Section.

.3 Before starting Work, obtain written approval of identification system from Contract Administrator.

2.4 Identification of Piping Systems

.1 Identify contents by background colour marking, pictogram (as necessary), legend, direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Contract Administrator.

.2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background Colour Marking	Legend
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT

.8 Valves:

.1 Provide coloured, 3 mm thick, 40 mm square, 2-ply laminated plastic with bevelled edges with 12 mm high text, red-white, green-white, yellow-black, etc., to match the piping classification colour, each complete with a 3.2 mm diameter by 100 mm long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:

HV-P601
100 mm

.2 Provide neat, typewritten directories, giving valve number, services and location. Frame one (1) copy under glass for wall mounting as directed, second copy to be forwarded to the City. Include copies in O&M Manuals.

2.5 Identification Ductwork Systems

.1 Ductwork:

.1 All ductwork in to be identified as follows, complete with directional arrows:

Exhaust Air:	EA
Return Air:	RA
Supply Air:	SA
Chlorine Exhaust:	WA

.2 Identify the usage of duct access panels with coloured 3 mm thick, 25 mm x 40 mm square, 2-ply laminated plastic with bevelled edges with 12 mm high text. Apply lamicoids conforming to the following schedule.

Service	Background Colour	Text Colour	Text
Cleaning and service access	Yellow	Black	C.A.
Controls, including heat sensors	Black	White	C.
Dampers (balance & control)	Blue	White	D

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 datasheet.

3.2 Timing

.1 Provide identification only after painting specified Section 09 91 00 - Painting has been completed.

3.3 Installation

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and/or CSA registration plates as required by respective agency.

.3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 Nameplates

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.5 Location of Identification on Piping and Ductwork Systems

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 Valves, Controllers

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Contract Administrator. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.7 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

1. GENERAL

1.1 Summary

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 Qualifications of Tab Personnel

.1 Submit names of personnel to perform TAB to the Contract Administrator within ninety (90) days of award of Contract.

.2 Provide documentation confirming qualifications, successful experience.

.3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:

.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this Contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 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 to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 Exceptions

.1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 Co-ordination

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 Pre-Tab Review

.1 Review Contract Documents before project construction is started and confirm in writing to the Contract Administrator adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to the Contract Administrator in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 Start-Up

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 Operation of Systems During Tab

.1 Operate systems for length of time required for TAB and as required by the Contract Administrator for verification of TAB reports.

1.9 Start of Tab

.1 Notify the Contract Administrator seven (7) days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, and caulking.

.5 Pressure, leakage, other tests specified elsewhere Division 23.

.6 Provisions for TAB installed and operational.

.7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Duct systems clean.

.2 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.3 Correct fan rotation.

.4 Fire, smoke, volume control dampers installed and open.

.5 Access doors, installed, closed.

.6 Outlets installed, volume control dampers open.

1.10 Application Tolerances

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: +5%, -5%.Accuracy Tolerances.

.2 Measured values accurate to within + / -2% of actual values.

1.11 Instruments

.1 Prior to TAB, submit to the Contract Administrator list of instruments used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within three (3) months of TAB. Provide certificate of calibration to the Contract Administrator.

1.12 Action and Informational Submittals

.1 Submit, prior to commencement of TAB:

.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.13 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:

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 Summaries.

1.14 Tab Report

.1 Format in accordance with AACB or NEBB templates.

.2 TAB report to show results in SI units and to include:

.1 Project Record Drawings.

.2 System schematics.

.3 Submit two (2) copies of TAB Report to the Contract Administrator for verification and approval, in English in D-ring binders, complete with index tabs.

1.15 Verification

.1 Reported results subject to verification by the Contract Administrator.

.2 Provide personnel and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results as directed by the Contract Administrator.

.4 Pay costs to repeat TAB as required to satisfaction of the Contract Administrator.

1.16 Settings

.1 After TAB is completed to satisfaction of the Contract Administrator, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.17 Completion of Tab

.1 TAB considered complete when final TAB Report received and approved by the Contract Administrator.

1.18 Air Systems

.1 Standard: TAB to most stringent of this section or TAB standards of AABC or NEBB.

.2 Do TAB of systems, equipment, components, controls specified Division 23.

.3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB qualified to standards of AABC or NEBB.

.4 Quality assurance: perform TAB under direction of supervisor qualified by AABC or NEBB.

.5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.6 Locations of equipment measurements: to include as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.19 Other Tab Requirements

.1 General requirements applicable to work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.

.2 Quality assurance: as for air systems specified this section.

1.20 Post-Occupancy Tab

.1 Participate in systems checks twice during Warranty Period - #1 approximately three (3) months after acceptance and #2 within one (1) month of termination of Warranty Period.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

DUCT INSULATION

1. GENERAL

1.1 Related Requirements

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Section 23 31 13.01 - Metal Ducts – Low Pressure to 500 Pa.

.6 Section 23 33 00 - Air Duct Accessories.

.7 Section 23 33 15 - Dampers – Operating.

.8 Section 23 34 00 - HVAC Fans.

.9 Section 23 37 20 - Louvres, Intakes and Vents.

1.2 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 ASTM International (ASTM):

.1 ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547, Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.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 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.5 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 Definitions

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - means "not concealed" as previously defined.

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork.

.2 CRF: Code Rectangular Finish.

1.4 Action and Informational Submittals

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Description of equipment giving manufacturer's name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

.3 Samples:

.1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.

.2 Mount sample on 12 mm plywood board.

.3 Affix typewritten label beneath sample indicating service.

.4 Manufacturers' Instructions:

.1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.

1.5 Quality Assurance

.1 Qualifications:

.1 Installer: specialist in performing work of this section, and have at least three (3) years successful experience in this size and type of project, qualified to standards and a member of TIAC.

1.6 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Fire and Smoke Rating

.1 To CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

.1 Mineral fibre: to ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C553.

2.3 Jackets

.1 Aluminum:

.1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Stucco embossed.

.4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.

2.4 Accessories

.1 Vapour retarder lap adhesive:

.1 Water based, fire retardant type, compatible with insulation.

.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168.

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

.5 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.

.6 Tie wire: 1.5 mm stainless steel.

.7 Banding: 19 mm wide, 0.5 mm thick stainless steel.

.8 Fasteners: 4 mm diameter pins with 35 mm square clips, length to suit thickness of insulation.

3. EXECUTION

3.1 Application

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Pre-Installation Requirements

.1 Pressure test ductwork systems complete, witness and certify.

.2 Ensure surfaces are clean, dry, free from foreign material.

3.3 Installation

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and as indicated.

.3 Use two (2) layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Ensure hangers, and supports are outside vapour retarder jacket.

.5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum two (2) rows each side.

3.4 Ductwork Insulation Schedule

.1 Insulation types and thicknesses: conform to following table:

.2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.1 Finishes: conform to following table:

	TIAC Code		Thickness (mm)	Jacket
	Rect	**Round**		
Indoor, concealed	none	none	-	
Indoor, exposed within mechanical room	CRF/1	CRD/2	-	
Indoor, outdoor air intakes	CRF/2	CRD/3	50	Aluminum
Indoor, exhaust	CRF/2	CRD/3	25	Aluminum
Outdoor, exposed to precipitation	CRF/3	CRD/4	50	Aluminum
Outdoor, elsewhere	CRF/4	CRD/5	50	Aluminum

3.5 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

1. GENERAL

1.1 Related Requirements

.1 Section 22 05 00 - Common Work Results for Plumbing.

.2 Section 22 11 16 - Domestic Water Piping.

1.2 Reference Standards

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

.1 ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 ASTM International (ASTM):

.1 ASTM B209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

.2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533, Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547, Mineral Fiber Pipe Insulation.

.7 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB):

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts.

.4 Department of Justice Canada (Jus):

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

.6 Manufacturer's Trade Associations:

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.7 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings.

.4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 Definitions

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 Action and Informational Submittals

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.

.3 Shop Drawings:

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

.4 Samples:

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

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.1 The Contract Administrator will make available one (1) copy of systems supplier's installation instructions.

1.5 Quality Assurance

.1 Qualifications:

.2 Installer: specialist in performing work of this Section and have at least three (3) years successful experience in this size and type of project and be a member of TIAC.

1.6 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the Site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

2.3 Insulation Securement

.1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 Vapour Retarder Lap Adhesive

.1 Water based, fire retardant type, compatible with insulation.

2.5 Indoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.6 Outdoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.7 Jackets

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: to match existing.

.3 Minimum service temperatures: -20°C.

.4 Maximum service temperature: 65°C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Thickness: 0.5 mm.

.7 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

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 datasheet.

3.2 Pre-Installation Requirement

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 Installation

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and this specification.

.3 Use two (2) layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.5 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 Removable, Pre-Fabricated, Insulation and Enclosures

.1 Application: at valves, flanges and unions at equipment.

.2 Design: to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: PVC.

3.5 Piping Insulation Schedules

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-3.

.1 Securements: SS bands, Tape at 300 mm on centre.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.3 Thickness of insulation as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 4000 mm long.

.2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	**Temp °C**	**TIAC code**	**Pipe sizes (NPS) and insulation thickness (mm)**					
			Run out	**to 1**	**1 1/4 to 2**	**2 1/2 to 4**	**5 to 6**	**8 & over**
Domestic HWS		A-1	25	25	25	38	38	38
Domestic CWS		A-3	25	25	25	25	25	25
Domestic CWS with vapour retarder		C-2	25	25	25	25	25	25

.4 Finishes:

.1 Exposed indoors: PVC jacket.

.2 Exposed in mechanical rooms: PVC jacket.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.6 Field Quality Control

.1 Verification requirements include:

.1 Materials and resources.

.2 Storage and collection of recyclables.

.3 Construction waste management.

.4 Resource reuse.

.5 Recycled content.

.6 Local/regional materials.

.7 Certified wood.

.8 Low-emitting materials.

3.7 Cleaning

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC

1. GENERAL

1.1 Related Requirements

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 PA.

.6 Section 23 33 00 - Air Duct Accessories.

.7 Section 23 33 15 - Dampers – Operating.

.8 Section 23 34 00 - HVAC Fans.

.9 Section 23 37 13 - Diffusers, Registers and Grilles.

.10 Section 23 37 20 - Louvres, Intakes and Vents.

1.2 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 electric and electronic control system for HVAC and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Damper Operators

.1 Spring return, 120 VAC operating voltage, 0-10 VDC input signal, 0-10 VDC position output signal, 80 seconds maximum driving time for 95-degree operation and 30 seconds maximum spring return time, with visual position indicator and manual override.

.2 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one (1) damper operator per damper section.

.3 Basis of Design:

.1 Belemo.

.2 Honeywell.

.3 Siemens.

.4 Or equivalent.

3. EXECUTION

3.1 Installation

.1 Install control devices.

3.2 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

1. GENERAL

1.1 Related Requirements

.1 Section 07 84 00 - Fire Stopping.

.2 Section 07 92 00 - Joint Sealants.

.3 Section 23 05 00 - Common Work Results for HVAC.

.4 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.5 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.6 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.7 Section 23 09 33 - Electric and Electronic Control System for HVAC.

.8 Section 23 33 00 - Air Duct Accessories.

.9 Section 23 33 15 - Dampers – Operating.

.10 Section 23 34 00 - HVAC Fans.

.11 Section 23 37 13 - Diffusers, Registers and Grilles.

.12 Section 23 37 20 - Louvres, Intakes and Vents.

1.2 Reference Standards

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

.2 ASTM International (ASTM):

.1 ASTM A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.

.3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 Green Seal Environmental Standards (GS):

.1 GS-36, Standard for Adhesives for Commercial Use.

.4 National Fire Protection Association (NFPA):

.1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.

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 metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Test and Evaluation Reports:

.1 Certification of Ratings:

.1 Catalogue or published ratings to be those obtained from tests carried out by the manufacturer or independent testing agency signifying adherence to codes and standards.

1.4 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the Site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Seal Classification

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C

.2 Seal classification:

.1 Class C: transverse joints and connections made airtight with gaskets, sealant, tape, or a combination thereof. Longitudinal seams unsealed.

2.2 Sealant

.1 Sustainability Characteristics:

.1 Adhesives and sealants: in accordance with Section 07 92 00 - Joint Sealants.

.2 Adhesives and sealants: VOC limit 30 g/L maximum to SCAQMD Rule 1168 GS-36.

.2 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of -30°C to+93°C.

2.3 Tape

.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 Duct Leakage

.1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 Fittings

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: standard radius.

.2 Round: five-piece, centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 407 mm: with single thickness turning vanes.

.2 Over 407 mm: with double-thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct.

.2 Round main and branch: enter the main duct at 45 degrees with conical connection.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.6 Offsets:

.1 Full radiused elbows as indicated.

2.6 Fire Stopping

.1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Fire Stopping.

.2 Coordinate with 07 84 00 - Fire Stopping to ensure fire-stopping materials and installation does not distort duct.

2.7 Galvanized Steel

.1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

2.8 Stainless Steel

.1 To ASTM A480/A480M, Type 304.

.2 Finish: number 4.

.3 Thickness, fabrication and reinforcement: to SMACNA.

.4 Joints: to be continuous inert gas welded.

2.9 Hangers and Supports

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Strap hangers: of the same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp.

.3 For steel beams: manufactured beam clamps:

3. EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with the manufacturer's written instructions.

.1 Visually inspect the substrate in the presence of the Contract Administrator.

.2 Inform the 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 the Contract Administrator.

3.2 General

.1 Do work in accordance with NFPA 90A and SMACNA.

.2 Do not break the continuity of the insulation vapour barrier with hangers or rods.

.1 Insulate strap hangers 100 mm beyond the insulated duct.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate the installation of acoustic duct lining.

3.3 Hangers

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.4 Sealing and Taping

.1 Apply sealant in accordance with SMACNA to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one (1) coat of sealant to manufacturers recommendations.

3.5 Leakage Tests

.1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.2 Do leakage tests in sections.

.3 Make trial leakage tests as instructed to demonstrate workmanship.

.4 Do not install additional ductwork until trial test has been passed.

.5 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.6 Complete test before performance insulation or concealment Work.

3.6 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

AIR DUCT ACCESSORIES

1. GENERAL

1.1 Related Requirements

.1 Section 23 05 00 - Common Work Results for HVAC

.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Section 23 09 33 - Electric and Electronic Control System for HVAC.

.6 Section 23 31 13.01 - Metal Ducts – Low Pressure to 500 Pa.

.7 Section 23 33 15 - Dampers – Operating.

.8 Section 23 34 00 - HVAC Fans.

.9 Section 23 37 13 - Diffusers, Registers and Grilles.

.10 Section 23 37 20 - Louvres, Intakes and Vents.

1.2 Reference Standards

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

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 air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

1.4 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the Site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 General

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 Flexible Connections

.1 Frame: galvanized sheet metal frame 50 mm thick with fabric clenched by means of double-locked seams.

.2 Material:

.1 Fire-resistant, self-extinguishing, neoprene-coated glass fabric, temperature rated at -40°C to +90°C, density of 1.3 kg/m^2.

2.3 Access Doors In Ducts

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks complete with safety chain.

3. EXECUTION

3.1 Installation

.1 Flexible Connections:

.1 Install in following locations:

.1 Inlets and outlets of exhaust and return air fans.

.2 As indicated.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:

.1 Size:

.1 200 x 200 mm for viewing.

.2 Locations:

.1 Control dampers.

.2 Devices requiring maintenance.

.3 Required by code.

.3 Turning Vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.2 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

DAMPERS - OPERATING

1. GENERAL

1.1 Related Requirements

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Section 23 09 33 - Electric and Electronic Control System for HVAC.

.6 Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 PA.

.7 Section 23 33 00 - Air Duct Accessories.

.8 Section 23 34 00 - HVAC Fans.

.9 Section 23 37 13 - Diffusers, Registers and Grilles.

.10 Section 23 37 20 - Louvres, Intakes and Vents.

1.2 Reference Standards

.1 ASTM International (ASTM):

.1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

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 dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 Closeout Submittals

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into the manual.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Multi-Leaf Dampers

.1 Opposed blade type as indicated.

.2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Operator: to Section 23 09 33 - Electric and Electronic Control System for HVAC.

.6 Performance:

.1 Leakage: in closed position less than 2% of rated airflow at 25 Pa differential across damper.

.2 Pressure drop: at full open position less than 25 Pa differential across damper at 2.5 m/s.

.7 Insulated aluminum dampers:

.1 Frames: insulated with extruded polystyrene foam with RSI 0.88.

.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

.8 Basis of Design:

.1 Tamco.

.2 Greenheck.

.3 Nailor.

3. EXECUTION

3.1 Installation

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Ensure dampers are observable and accessible.

3.2 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

1. GENERAL

1.1 Related Requirements

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Section 23 09 33 - Electric and Electronic Control System for HVAC.

.6 Section 23 31 13.01 - Metal Ducts – Low Pressure to 500 Pa.

.7 Section 23 33 00 - Air Duct Accessories.

.8 Section 23 33 15 - Dampers – Operating.

.9 Section 23 37 13 - Diffusers, Registers and Grilles.

.10 Section 23 37 20 - Louvres, Intakes and Vents.

1.2 Reference Standards

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA):

.1 ANSI/AMCA Standard 99, Standards Handbook.

.2 ANSI/ASHRAE 51 (ANSI/AMCA 210), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.

.4 ANSI/AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 The Master Painters Institute (MPI):

.1 Architectural Painting Specification Manual.

.1 MPI #18, Primer, Zinc Rich, Organic.

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 HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide:

.1 Fan performance curves showing point of operation, kW and efficiency.

.2 Sound rating data at point of operation.

.2 Indicate:

.1 Motors, sheaves, bearings, shaft details.

.2 Minimum performance achievable.

1.4 Maintenance Material Submittals

.1 Extra Materials:

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

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 off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect HVAC fans from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 System Description

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: Refer to schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.

.4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

2.2 Fans General

.1 Motors:

.1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 For use with variable speed controllers.

.3 Sizes as indicated.

.2 Accessories and hardware: matched sets of V-belt drives, adjustable motor bases, belt guards, coupling guards fan inlet and or outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

.3 Factory primed before assembly in colour standard to manufacturer.

.4 Scroll casing drains: as indicated.

.5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.6 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.3 In-Line Centrifugal Fans

.1 Fan wheels:

.1 Belt drive, welded aluminum construction.

.2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.

.3 Backward inclined blades.

.2 Bearings: heavy-duty or split pillow-block grease lubricated ball or roller self-aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 hours.

.3 Housings:

.1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel for smaller wheels, braced, and with welded construction and supports.

.4 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

.5 Basis of Design:

.1 Greenheck.

.2 Cook.

.3 Twin City.

3. EXECUTION

3.1 Fan Installation

.1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

3.2 Anchor Bolts and Templates

.1 Size anchor bolts to withstand seismic acceleration and velocity forces.

3.3 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

DIFFUSERS, REGISTERS AND GRILLES

1. GENERAL

1.1 Related Requirements

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Section 23 31 13.01 - Metal Ducts – Low Pressure to 500 Pa.

.6 Section 23 33 00 - Air Duct Accessories.

.7 Section 23 33 15 - Dampers – Operating.

.8 Section 23 34 00 - HVAC Fans.

.9 Section 23 37 20 - Louvres, Intakes and Vents.

1.2 Reference Standards

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 diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

.3 Maintenance Material Submittals

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include:

.1 Keys for volume control adjustment.

.2 Keys for air flow pattern adjustment.

1.4 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the Site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 System Description

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 General

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.2 Frames:

.1 Full perimeter gaskets.

.2 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: standard.

2.3 Manufactured Units

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.4 Supply Grilles and Registers

.1 General: with opposed blade dampers

.2 Type SG-1: aluminum, 21 mm exposed duct border, single deflection with airfoil shape horizontal face bars. factory applied powder coat, colour to be confirmed.

.3 Basis of Design:

.1 Greenheck.

.2 Titus.

.3 Nailor.

.4 Or equivalent.

2.5 Return and Exhaust Grilles and Registers

.1 General: with opposed blade dampers.

.2 Type EX-1: aluminum, exposed duct border, 25 x 25 mm, 0° egg crate type face bars. Finish: factory applied powder coat, colour to be confirmed.

.3 Basis of Design:

.1 Greenheck.

.2 Titus.

.3 Nailor.

.4 Or equivalent.

3. EXECUTION

3.1 Installation

.1 Install in accordance with manufacturers instructions.

.2 Install with oval head, stainless steel screws in countersunk holes where fastenings are visible.

3.2 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

LOUVRES, INTAKES AND VENTS

1. GENERAL

1.1 Related Requirements

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Section 23 31 13.01 - Metal Ducts – Low Pressure to 500 Pa.

.6 Section 23 33 00 - Air Duct Accessories.

.7 Section 23 33 15 - Dampers – Operating.

.8 Section 23 34 00 - HVAC Fans.

.9 Section 23 37 13 - Diffusers, Registers and Grilles.

1.2 Reference Standards

.1 ASTM International (ASTM):

.1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.2 National Fire Protection Association (NFPA):

.1 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.3 National Research Council Canada (NRC):

.1 National Building Code of Canada (NBC).

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.5 Society of Automotive Engineers (SAE).

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 louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.4 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 System Description

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 Fixed Louvres - Aluminum

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminum alloy 6063-T5.

.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.

.4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.

.5 Mullions: at 1500 mm maximum centres.

.6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.7 Screen: 12 mm exhaust, 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.

.8 Finish: factory applied enamel. Colour: to be confirmed.

.1 Greenheck.

.2 Titus.

.3 Nailor.

.4 Or equivalent.

3. EXECUTION

3.1 Installation

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.2 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

1. GENERAL

1.1 Related Requirements

.1 Section 23 05 00 - Common Work Results for HVAC

.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

.5 Section 23 31 13.01 - Metal Ducts – Low Pressure to 500 Pa

.6 Section 23 33 00 - Air Duct Accessories

.7 Section 23 33 15 - Dampers – Operating

.8 Section 23 34 00 - HVAC Fans

.9 Section 23 37 20 - Louvres, Intakes and Vents

1.2 Reference Standards

.1 ASTM International (ASTM):

.1 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 ASTM C916, Standard Specification for Adhesives for Duct Thermal Insulation.

.3 ASTM C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.2 National Fire Protection Association (NFPA):

.1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems (ANSI).

.3 Underwriters' Laboratories (UL) Inc.

.1 UL 2021, Fixed and Location-Dedicated Electric Room Heaters.

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 unit heaters and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures.

.4 Shop Drawings:

.1 Indicate on Drawings:

.1 Equipment, capacity and piping connections.

.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

1.4 Closeout Submittals

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for unit heaters for incorporation into manual.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to the site in original factory packaging, labelled with the manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off-ground, indoors, and in complete accordance with the manufacturer's recommendations in clean, dry, well-ventilated areas.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Electric Unit Heaters

.1 Casing: 1.4 mm thick cold rolled steel, powder coat, with threaded connections for hanger rods.

.2 Fan: direct drive propeller type, factory balanced, with anti-corrosive finish.

.3 Motor: speed as indicated, continuous duty, ball bearing motor with built-in overload protection, and resilient motor supports.

.4 Air outlet: adjustable multi-vane diffuser with finish to match casing.

.5 Control: Remote room thermostat, electric, low voltage, cover, set point locking device.

3. EXECUTION

3.1 Installation

.1 Install in accordance with manufacturer's instructions.

.2 Include double swing pipe joints as indicated.

.3 Check final location with Contract Administrator if different from that indicated prior to installation.

.1 Should deviations beyond allowable clearances arise, request and follow Contract Administrator directive.

.4 Provide supplementary suspension steel as required.

.5 Install thermostats in locations indicated.

.6 Before acceptance, set discharge patterns and fan speeds to suit requirements.

3.2 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

END OF SECTION

SCHEDULES

1. GENERAL

1.1 Scope

.1 Schedules in this section:

.1 Exhaust Fans.

.2 Unit Heaters.

2. PRODUCTS

2.1 Exhaust Fans

Tag	EF-U6001	EF-U6002	EF-6003
Function	Channel Exhaust	Channel Exhaust	Room Exhaust
Location	East Side	West Side	Storage Room
Volume, L/s	950	950	142
E.S.P. Press, Pa	250	250	125 Pa
Fan Speed, RPM	1941	1941	1,296
Motor Power, kW	0.6	0.6	0.09
Power Supply	600/60/3	600/60/3	115/60/1
Drive	Belt	Belt	Belt
Type	Centrifugal	Centrifugal	Centrifugal
Arrangement	Ground Mounted	Ground Mounted	Inline
Manufacturer	Greenheck	Greenheck	Greenheck
Model	Vecktor	Vecktor	BSQ
Control	See Specification	See Specification	See Specification
Accessories & Remarks	See Specification	See Specification	See Specification

Accessories :

1. Gasketted bolted access door
2. Housing drain with plug
3. Totally enclosed belt guard
4. Shaft and bearing guard
5. Extended grease fittings
6. Fan base and vibration isolators
7. Weatherproof motor
8. Drive cover
9. Shaft seal

2.2 Unit Heaters

Tag	**UH-U6010**	**UH-U6020**
Location	Storage Room	Storage Room
Heating Medium	Electric	Electric
Capacity, kW	10 kW	10 kW
Liquid Entering Temp., ºC	-	-
Liquid Leaving Temp., ºC	-	-
Design Liquid Flow, L/s	-	-
Max. Liquid P.D., kPa	-	-
Air Flow, L/s	330	330
Max Fan Speed,	1550	1550
Motor Power, W	0.25	0.25
Power Supply, V/Hz/Ph	660/3/1	660/3/1
Arrangement	Vertical	Vertical
Manufacturer	Ouellet	Ouellet
Accessories & Remarks	See Specification	See Specification

END OF SECTION

1. GENERAL

1.1 Related Sections

.1 Requirements specified within this section apply to all sections in Division 26, Electrical. This section supplements requirements of other Divisions.

1.2 Codes and Standards

.1 Manitoba Building Code (MBC).

.2 The Winnipeg Electrical By-law (WEB).

.3 CSA C22.1 Canadian Electrical Code - Part 1 (CEC).

.4 CSA C22.2 No. 0 General Requirements - Canadian Electrical Code - Part 2.

.5 CAN3-C235 Preferred Voltage Levels for AC Systems, 0-50,000 V.

.6 Electrical and Electronic Manufacturers Association of Canada (EEMAC).

.7 National Electrical Manufacturers Association (NEMA).

.8 Institute of the Electrical and Electronic Engineers (IEEE).

.9 Insulated Cable Engineers Association (ICEA).

.10 Canadian Standards Association (CSA).

.11 Underwriters Laboratories Canada (ULC).

.12 American National Standards Institute (ANSI).

.13 National Fire Protection Agency (NFPA).

.14 Comply with the most current locally enforced edition of CSA C22.1 Canadian Electrical Code - Part 1, Winnipeg Electrical By-law, Provincial Safety Electrical Authority Codes and Bulletins.

.15 Comply with all laws, ordinances, rules, regulations, codes, and orders of all Authorities Having Jurisdiction relating to this Work. Where these regulations conflict, comply with the most stringent condition.

.16 Comply with latest editions of the CSA Certification Standards and Bulletins.

1.3 Drawings and Specifications

.1 All materials, equipment, labor, work denoted on the Drawing set is to be considered as new work, to be provided by the Contractor unless specifically noted otherwise. Some of the electrical and automation Drawings show existing systems (with modifications to these systems). These Drawings specifically indicated that there are existing systems shown.

Where Drawings do not specifically indicate that existing systems are depicted, the Contractor shall assume that the materials, equipment, labor, work indicated will form part of his scope, and the Contractor shall include all costs (including materials, labor, etc.) to perform the work.

.2 Prior to installing power and control cabling for process equipment, the Contractor shall review the equipment Shop Drawings, and to ensure that cabling requirements are understood. There may be variations in wiring requirements with process and HVAC equipment, that may require alternate wiring requirements from that shown on the Drawings. Include such wiring and connections in tender at no additional costs.

.3 The electrical Drawings in some cases indicate the size of cables, breakers, conduits, etc. These sizes are based on the supply of specific sizes of equipment. For cases where the Contractor supplies equipment that varies from these assumptions it is the responsibility of the Contractor to provide the correct size of breaker, cable, etc. to suit the installation, at no additional cost to the Contract.

.4 The intent of the Drawings and Specifications is to indicate labor, products, and services necessary for a complete, installed, tested, commissioned and functional installation.

.5 Electrical Drawings may indicate approximate route to be followed by conduits and cables and general location of electrical equipment. They do not show all structural, architectural and mechanical details. In some cases, conduit or wiring is only shown diagrammatically on the Drawings. The details on exact cable or conduit routing, and exact equipment installation location is to be determined on site and coordinated with all other trades.

.6 Where circuit numbers are shown adjacent to equipment, the Electrical Contractor shall provide all wiring, conduit, supports, and any other requirements to provide power to that piece of equipment from the circuit indicated. Where circuit numbers are not shown adjacent to a piece of 575 V equipment, refer to the single line drawings for connections details. Provide all wiring, conduit, supports, and any other requirements to provide power to that piece of equipment.

.7 To provide sufficient detail and maximum degree of clarity on the Drawings, symbols used for various electrical devices, particularly wall mounted devices, take up more space on the Drawings than devices physically do. Locate devices with primary regard for convenience of operation, accessibility and space utilization, rather than locating devices to comply with the exact scaled locations of the electrical symbols.

.8 If discrepancies or omissions in the Drawings or Specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting a Bid.

.9 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

.10 Various package unit types of equipment are included in the work. It is the responsibility of the Contractor to familiarize themselves with the requirements of the equipment vendor, and to include all materials and labor for a complete and working installation. In some cases this means that motors, valves, actuators, etc. need to be wired and connected in the field. The Contractor shall include all costs to perform such services as part of his Tender submittal. Coordination between the equipment vendor and the Contractor shall be performed prior to

Tender bid closing date, and all costs shall be included in the tender. Request for extras due to lack of coordination between the Contractor and the equipment vendors will not be accepted.

.11 In some cases the plan Drawings indicate the symbol for 1 motor - for package units – when in reality, there are multiple motors, valves, dampers, solenoids, associated with the piece of equipment. It is the responsibility of the Contractor to understand the intricacies of the packaged equipment, and to perform all field connections for a complete and working system.

.12 In some cases motorized dampers are shown only with one symbol on the Drawings, when in fact multiple motorized dampers are required in order to accommodate the opening size and the actuators. In these cases it is the responsibility of the Contractor to wire and connect all required actuators to allow for correct operation of the system at no additional cost.

.13 Cables schedules / lists where shown do not include all cables required to perform the complete Facility installation. They shall be used as a general guide. Accurate cable lists, quantities, take-offs remain the responsibility of the Contractor. Cable schedules only show cabling where specific cable tags are available on the Drawings. Refer to the cable schedule for specific systems which are not included on the schedule, and include materials, and installation for all remaining cabling.

1.4 Care, Operation, and Start-Up

.1 Instruct the Contract Administrator’s maintenance and operating personnel in the operation, care and maintenance of systems, system equipment and components.

.2 Where services of a Manufacturer’s Factory Service Engineer is required, arrange and pay for services to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide factory service engineer support for such a period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are familiar and fully trained with all aspects of its care and operation.

1.5 Permits, Fees, and Inspection

.1 The Contract Administrator will submit to Electrical Inspection Department and Supply Authority necessary number of Drawings and Specifications for examination and approval prior to commencement of Work.

.2 The Contractor shall pay associated fees as required by the Electrical Inspections and Permitting department.

.3 Notify the Contract Administrator of changes required by Electrical Inspection Department prior to making changes.

.4 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.

1.6 Definitions

.1 The following are definitions used in Division 26.

.1 Inspection Authority means agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical Site Work.

.2 Supply Authority or Supply Utility means electrical power company or commission responsible for delivering electrical power to the Project Site.

.3 Electrical Code or Code means the Electrical Code in force at the project location.

.4 CEC means Canadian Electrical Code (latest edition being enforced by law).

.5 Contractor and Electrical Contractor means the entity retained to perform the Work listed herein.

.6 Contract Administrator means the person with the authority to make decisions and administer the Contract on behalf of the City.

.7 Provide means to supply, install, wire, connect, test, commission and leave in complete and working order.

.8 The term “Shop Drawing” means Drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data, which are to be provided by the Contractor to illustrate details of a portion of the Work.

1.7 Design Requirements

.1 Design equipment, anchorage, and support systems for vertical and lateral loading in accordance with MBC.

.2 Operating voltages to be within those defined in CAN3-C235.

.3 Verify before energization that equipment supplied under this Contract is compatible with the site electrical power supply system.

.4 All equipment, devices and installation methods (even where not specifically expressed on the Drawings) shall comply with the Manitoba Energy Code for Buildings (MECB).

1.8 Electrical Coordination

.1 Coordinate Work with all other trades to ensure that conflicts do not occur.

.2 Coordinate requirement of mechanical equipment requiring electrical connection with the Mechanical Contractor. Pay specific attention to equipment full load amps, voltage, phase and breaker size.

.3 Verify that all equipment ordered is compliant with the Manitoba Energy Code for Buildings.

.4 Coordinate work with utilities where appropriate, including but not limited to:

.1 Incoming overhead lines,

.2 Underground buried services,

.3 Transformer(s) supplying main electrical service to the Facility,

.4 Installation of Supply Authority meter, and

.5 Installation of incoming telephone / data communication service conductors or cables.

1.9 Submittals

.1 Permits, Fees and Inspection:

.1 Furnish copies of all inspection reports and Certificate of Final Acceptance from Electrical Inspection Authority and any authorities having jurisdiction on completion of Work to Contract Administrator and include copies in the O & M manuals.

.2 Site Documentation:

.1 In each electrical room, provide power distribution system single line diagrams in glazed metal frames.

.2 Provide fire alarm riser diagram, plan and building zoning in glazed metal frame at fire alarm control panel and annunciator to meet requirements of Fire Commissioner.

.3 Where work includes modification to existing power distribution or fire alarm systems, provide new single line and riser diagrams showing complete modified system. Reinstall diagram into existing frames where feasible or provide new frame and glazing.

.3 Within fifteen (15) days of award of the Contract, the Contractor shall submit a completed equipment procurement schedule, which lists the Manufacturer and model of equipment, indicating the projected ordering, Shop Drawing submittal date and delivery dates of all products to meet the required construction schedule.

.4 Prior to delivery of any products to the job Site and sufficiently in advance of requirements to allow ample time for checking, submit Shop Drawings for review as specified in Division 1.

.5 Submit Shop Drawings (including product data) for all equipment as required in each Section of this Specification.

.6 Prior to submitting the Shop Drawings to the Contract Administrator, the Contractor shall review, date and sign the Shop Drawings to determine that the equipment complies with the requirements of the Specifications and Drawings.

.7 Shop Drawings shall indicate materials, methods of construction and attachment of support, wiring diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of the Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the Section under which the adjacent items will be supplied and installed. Indicate cross-references to design Drawings and Specifications. Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract price. If adjustments affect the value

of the Work, state so in writing to the Contract Administrator prior to proceeding with the Work.

.8 Manufacture of products shall conform to the revised Shop Drawings. Failure to supply a product based on the revised, marked up Shop Drawings may require on site product revisions or modifications, which will be at the cost of the Contractor.

.9 Keep one (1) complete set of Shop Drawings at job Site during construction.

.10 Prior to shipping prefabricated control panels, photos of completed panels shall be sent to the Contract Administrator of final review. The resolution of the photos should be such that individual wire tags can be read.

.11 Shop Drawings shall have the specific equipment numbers on all pages to clearly indicate which piece of equipment the Shop Drawing refers to. In addition, the entire product part number or catalog number should be adjacent to the tag.

1.10 As-Built Drawings

.1 Refer to Section 01 78 00, Closeout Submittals - for additional requirements for As-Built Drawings.

.2 The Contractor shall keep one (1) complete set of white prints at the Site during work, including all addenda, change orders, site instructions, clarifications, and revisions for the purpose of As-Built Drawings. As the Work on-site proceeds, the Contractor shall clearly record in red pencil all as-built conditions, which deviate from the original Contract Documents. As-Built Drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.

.3 On completion of the Work, minimum of four (4) weeks prior to final inspection, submit As-Built Drawings to Contract Administrator for review. The Contractor shall certify, in writing signed and dated, that the As-Built drawings are complete and that they accurately indicate all electrical services, including exposed as well as concealed items.

.4 Print, frame, and mount all as-built single line drawings on size D sheet in the electrical room(s). For modifications to areas with existing electrical installations, replace the existing single line drawing with the latest As-Built.

.5 Comply with all other City of Winnipeg standards and requirements.

1.11 Operations and Maintenance (O&M) Manuals

.1 Provide operation and maintenance manuals as specified herein and in accordance with the general conditions. Refer to Section 01 78 23 - Operations and Maintenance Data.

.2 Include in the operations and maintenance manuals a minimum of:

.1 Cover page including project name, year, name of owner and electrical Subconsultant. Cover page shall be enclosed in a clear plastic cover.

.2 Index.

.3 List of manufacturers and supplier for all items.

.4 Names, address and phone number of all local suppliers for items included in maintenance manual.

.5 Stamped and signed Shop Drawings.

.6 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of portions or features of the installation.

.7 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.

.8 All test results performed. This includes, but is not limited to, fire alarm V.I report, grounding system tests, battery bank test results, genset tests, switchgear tests, operation tests, cable tests, MCC tests, load balancing tests, Hi Pot tests, Megger tests, factory tests of all major systems, etc. Submit test results on COW approved test sheets.

.9 Panel schedules (hardcopy and Microsoft Excel format).

.10 Software copies of relay settings

.11 As-Built Drawings.

.12 Signed and dated warranty certificate.

.13 Signed and dated approval by the local Electrical Inspections Department.

.14 All other requirements outlined in the Specifications.

.3 Submit draft document prior to the start of Commissioning.

.4 Comply with all other COW standards and requirements.

1.12 Environmental Conditions

.1 Equipment and systems are to be rated to correctly operate in the environment in which they are to be installed.

.2 Exterior devices shall be rated to operate in an exterior environment with temperature range of -40°C to +40°C.

1.13 Quality Assurance

.1 Qualifications:

.1 For work involving specialties, including, but not limited to, the installation of high voltage switchgear, high voltage cables, overhead pole lines, sound and intercommunication systems, fire alarm systems, lightning protection systems,

equipment cathodic protection, grounding systems, instrumentation, controls, electronic access, security systems, fibre optics systems, etc. employ only workers fully trained, qualified and experienced in the aspects of such work.

2. PRODUCTS

2.1 Accepted Materials

.1 Materials: approved by and bearing a CSA label. Where there is no alternative to supplying equipment or material that is not approved or certified as indicated, obtain and pay for special approvals from the Office of the Fire Commissioner, Inspection and Technical Services Manitoba.

.2 Factory assemble control panels and component assemblies. Control panels to be CSA certified. Include current interrupting rating on the front panel. Shop Drawings for custom built control panels (which are not designed and sealed as part of the Issued for Construction documents) shall be signed and sealed by an engineer, registered in the Province of Manitoba.

.3 Minimum enclosure type to be NEMA 12 unless otherwise specified. Refer to the Drawings and other Specification section for specific requirements.

.4 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.

2.2 Equipment Finish

.1 Where on Site finishing is required, prepare and prime surfaces as specified in Section 09 91 00 - Painting.

.2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

.3 Paint indoor switchgear and distribution enclosures light grey to ANSI 61 grey enamel, unless otherwise specified.

2.3 Equipment Identification

.1 Identify electrical equipment with nameplates as described below.

.2 Nameplates:

.1 Lamacoid, 3 mm thick plastic nameplates, mechanically attached with self tapping stainless steel screws, white face with black lettering. Note: “Sheet Metal Screws” or other sharp pointed screws are NOT acceptable.

.2 Sizes as follows:

Table 2.1: Nameplate Sizes

Size	Dimension	Lines of Text	Text Height
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	40 x 90 mm	2 lines	8 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	5 mm high letters
Size 8	35 x 100 mm	3 lines	5 mm high letters
Size 9	45 x 100 mm	4 lines	5 mm high letters
Size 10	75 x 160 mm	3 or 4 lines	8 mm high letters
Size 11	150 x 250 mm	3 or 4 lines	10 mm high letters

.3 Wording on nameplates to be approved by Contract Administrator prior to manufacture.

.4 Allow for average of fifty (50) letters per nameplate.

.5 Identification to be in English and by tag.

.6 Provide nameplates for the following, sizes as shown:

.1 Power, voice and data receptacles – Size 1.

.2 Panelboards – Size 9.

.3 Dry Type Transformer – Size 10.

.4 Cabinets – Size 8.

.5 Small Junction Boxes (150mm x 150mm or smaller) – Size 1.

.6 Large Junction Boxes – Size 2.

.7 Control panels – Size 8.

.8 Contactors – Size 8.

.9 Terminal / splitter cabinets – Size 8.

.10 MCCs, switchgear, distribution equipment – Size 10.

.11 Each cell or bucket in an MCC – Size 7.

.12 Each breaker cell located within switchgear – Size 5.

.13 Motor starters – Size 8.

.14 Light Switches – Size 1.

.15 Emergency lighting battery banks – Size 7 or Size 8.

.16 Emergency lights – Size 1.

.17 Exit signs – Size 3.

.18 Disconnect switch – Size 8.

.19 Wall mounted fire alarm devices – Size 2.

.20 Ceiling mounted fire alarm devices – Size 4.

.21 Oil filled padmount transformers – Size 11.

2.4 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.5 Conduit and Cable Identification

.1 Colour code conduits, boxes and cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.

.3 Colours: 38 mm wide prime colour and 19 mm wide auxiliary colours.

Table 2.2: Conduit and Cable Colour Code

System	Prime Band	Aux. Band
Medium Voltage (>750 V)	Orange	
347/600 V	Yellow	
120/208/240 V Power	Black	
UPS 120/208/240 V Power	Black	Green
Control Wiring (120 V)	Black	Orange
Fire Alarm	Red	
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring (<50 V)	Blue	Orange

System	Prime Band	Aux. Band
Intrinsically Safe	Blue	White
Ground	Green	
Fibre Optic	Purple	

.4 Cable Identification: Supply and install lamacoid type cable identification tags for all cables. Install identification tag at both ends.

3. EXECUTION

3.1 Preparation and Protection

.1 Schedule expediting of materials and execution of work in conjunction with associated work of other trades in order to meet the required work schedule.

.2 Post engraved warning signs to meet requirements of local by-laws, Inspection Authority and Contract Administrator.

.3 Protect those working on or in vicinity of exposed electrically energized equipment from physical danger. Shield and mark live parts in accordance with local regulations. Indicate the appropriate voltage.

.4 Arrange for installation of temporary doors, barriers and similar items for access to rooms and areas containing electrical equipment. Keep these doors locked at all times, except when under direct supervision.

.5 Permanently identify with lamacoid nameplate, equipment energized from multiple power sources, noting voltages, power source locations, supply disconnect designations and grounding electrode location.

3.2 Warning Signs

.1 As specified and to meet the requirements of Electrical Inspection Department and the Contract Administrator.

.2 Lamacoid 3 mm thick plastic engraving sheet, red face, white core, mechanically attached with self tapping screws, 20 mm text.

3.3 Mounting Heights

.1 Unless otherwise noted, or in contravention of codes and standards, mount equipment replacing existing equipment at the same height.

.2 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.

.3 If mounting height of equipment is not indicated, verify with the Contract Administrator before proceeding with the installation.

.4 Mount indoor electrical distribution equipment utilizing one of the following:

.1 Floor mount on 89 mm (3.5”) concrete housekeeping pad

.2 Surface wall mount to concrete walls (inside electrical rooms).

.3 For areas of elevated humidity or moisture (or where a suitable wall is not available) – mount on modular metal support system: Unistrut, Cantruss, or similar.

.4 Surface wall mount on 19 mm (3/4”) thick fire-retardant plywood backboard (for non structural type of walls and to provide a level of fire-retardant barrier where needed).

.5 Recess mount (as indicated on the Drawings).

.5 Install electrical equipment at the following heights unless indicated or directed otherwise (to bottom of the equipment):

.1 Outlets above counters: 150 mm (6”); splashbacks: 100 mm (4”).

.2 General receptacles & communications outlets: 400 mm (16”).

.3 Receptacles in mechanical and shop areas: 1 m (40”).

.4 Switches, dimmers, push buttons: 1.2 m (48”).

.5 Thermostats: 1.4 m (56”).

.6 Security alarm bells, horns, speakers: 2.2 m (88”).

.7 Motor starters: 1675 mm (66”) to top.

.8 Panelboard: 2.0 m (78”) to top.

.9 Control Panels: 1675 mm (66”) to top.

.10 Clock outlets: 2.15 m (84”).

.11 Emergency lighting battery bank unit: 2.1 m (82”).

.12 Emergency light remote head: 150 mm (6”) below ceiling, to a maximum height of 3.0 m (118”).

.13 Wall mount Exit signs: 2.2 m (87”) or higher as required to coordinate with door height.

.14 Pushbutton for power door assist: 900 mm (35.4”).

.15 Intrusion alarm motion detectors: 150 mm (6”) below ceiling, to a maximum height of 3.0 m (118”).

.16 Intrusion alarm keypad: 1500 mm (59”).

.17 Fire alarm panel: 1650 mm (65”) to top.

.18 End of line resistors: 1.6 m (64”).

.19 Fire alarm pull stations: 1320 mm (52”).

.20 Fire alarm horn / strobe: a minimum of 150 mm (6”) below ceiling to the top edge of the device (for low ceiling areas). Where ceilings allow, mount devices at 2400 mm (94.5”) (measured to top of device) above finished floor.

.21 Coordinate and confirm elevations indicated on the Architectural Drawings. Where discrepancies occur, request clarification from the Contract Administrator.

.22 Mounting heights to meet all codes and regulations. Fire alarm devices to be in accordance with CAN / ULC-S524.

.23 Coordinate and confirm elevations indicated on the Architectural elevations. Where discrepancies occur, request clarification from the Contract Administrator.

3.4 Location of Devices

.1 Allow for change of location of devices at no extra cost or credit, provided that the distance does not exceed 3000 mm (10’) from that shown on the Drawings, when the requirement is made known prior to installation.

3.5 Conduit and Cable Installation

.1 Sleeves through concrete: schedule 40 galvanized steel pipe, sized for free passage of conduit.

.2 For wall, partitions, and ceilings the sleeve ends shall be flush with the finish on both sides but for floors they shall extend 25 mm (1”) above finished floor level.

.3 Fire stop opening with ULC approved assembly for the installation conditions.

.4 Provide a detailed proposed conduit routing plan to the Contract Administrator prior to proceeding with the installation of conduit.

.5 If possible, avoid routing conduits through hazardous area.

.6 Separate cables of different voltage levels when cables are installed parallel to each other.

3.6 Cutting, Patching, Drilling

.1 Provide all cutting and patching as required.

.2 Return exposed surfaces to an as-found condition.

.3 Exercise care where cutting/drilling holes in existing concrete elements so as not to damage existing reinforcing, or any other systems run in the concrete.

.1 Locate reinforcing and other existing systems using ground penetrating radar, X-Ray or other suitable means. Mark out on the surface of the concrete the locations of rebar and all other systems.

.2 For all holes larger than 50 mm passing through reinforced concrete, mark the location of the desired hole and all embedded systems. Obtain approval from the Contract Administrator prior to cutting.

.4 Firestop and seal all penetrations.

.5 Ensure that water ingress will not occur.

.6 Provide expansion joints for penetrations where shifting can occur.

3.7 Anchor Installation

.1 The Contractor shall exercise care where installing anchors into existing concrete elements so as not to damage existing reinforcing. All anchors shall be installed utilizing carbide tip drill bits. The existing reinforcing shall be located utilizing a reinforcing bar locator and marked out on the surface of the concrete. The drill holes shall be advanced to the required depth for installation of the anchors. Should reinforcement be encountered while drilling the hole shall be terminated and repositioned to clear the reinforcement. Do not use core bits that can easily intercept and damage/cut the reinforcing during drilling.

3.8 Field Quality Control

.1 All electrical Work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties. A maximum of one (1) apprentice is permitted per qualified electrician.

.2 The Work of this Division to be carried out by a Contractor who holds a valid Master Electrical Contractor license as issued by the Province of Manitoba.

.3 Furnish Manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to Manufacturer's instructions.

3.9 Load Balance

.1 Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.

.2 Balance electrical load between phases as closely as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.

.3 When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit panel directory that lists final circuit arrangement.

3.10 Tests

.1 Test and check electrical, instrumentation and control systems for correct operation and compliance with statutory and regulatory authority requirements.

.2 Perform tests in presence of Contract Administrator. Log, tabulate, sign and include testing and Commissioning results in the O & M manuals.

.3 Testing shall include, but not be limited to, the following:

.1 All items indicated in Section 26 08 05 - Acceptance Testing and the testing and Commissioning requirements.

.2 Electrical power distribution systems.

.3 Wire and cable system.

.4 Lighting, emergency lighting, photocell, lighting controls and interlocks.

.5 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.6 Communications, control and instrumentation.

.7 Fire alarm and intercom systems.

.8 Standby genset power systems.

.9 All other equipment and systems as indicated in the Drawings and Specifications.

.4 Refer to appropriate Specification sections for specific system or equipment tests.

.5 Supply instruments, meters, consumable parts (such as fuses) and equipment. Arrange for qualified personnel to conduct tests.

.6 In cooperation with mechanical trades, take clamp-on ammeter readings with motors operating at full load. Compare values against the equipment nameplate rating. Log, tabulate and include readings in Maintenance Data and Operating Instructions.

.7 Correct systems which fail any test, correct and re-do tests to ensure proper operation of the system.

3.11 Checkout and Start-Up

.1 Voltage Field Test:

.1 Refer to Section 26 08 05, Acceptance Testing as applicable.

.2 Check Supply Utility voltage at point of termination of supply conductors when installation is essentially complete and is in operation.

.3 Check voltage amplitude between phases, and phase to neutral for loaded and unloaded conditions.

.4 Check voltage drop on at all distribution panels and ensure that it is less than 2% in accordance with CEC requirements.

.5 Check voltage drop on equipment loads and ensure that total voltage drop from the service to the farthest device is less than 5% in accordance with the CEC. Adjust transformer taps, and upsize conductors as required to meet the CEC.

.6 Unbalance Corrections:

.1 Make written request to the Supply Utility to correct conditions if the service voltage unbalance exceeds 3%.

.2 Current Field Tests:

.1 Make line current check after supply utility has made final adjustments to supply voltage.

.2 Check current balance at the service demarcation point. Adjust loads to ensure that each phase is appropriately balanced.

.3 Check line current in each phase for each piece of equipment.

.4 If the phase current for a piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.12 Touch-Up Painting

.1 Clean and touch-up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Obtain necessary touch-up paint of original type and quality from equipment Manufacturer.

.3 Clean surfaces to be painted. Feather out edges of scratch marks. Make patch inconspicuous.

.4 Apply one (1) or more coats until damaged surface has been restored to original finish condition.

.5 Clean and prime exposed non galvanized hangers, racks and fastenings to prevent rusting.

.6 Do not paint nameplates, tags, CSA labels, warning plates and operating instructions. Observe field painting of electrical equipment or raceways. Labels shall be visible and legible after the equipment is installed.

3.13 Cleaning

.1 Clean construction debris and materials from enclosures, before final electrical tests. Vacuum the interior and exterior of enclosures to ensure all equipment is free from debris.

3.14 Provision for Future Expansion

.1 In each electrical room, space has been left unoccupied for future equipment as per the City of Winnipeg's Water and Waste Department's Electrical Design Guide. Leave such space clean. Install conduit, wiring and other work in such a manner that necessary connections

can be made in future without dismantling existing equipment, raceways or wiring. Consult with Contract Administrator whenever necessary.

3.15 Breaker and Relay Settings

.1 The Electrical Contractor shall field adjust and set breaker and relay settings for all breakers, relays, VFDs, etc. in accordance with settings provided by the Contract Administrator. Settings will be provided to the Electrical Contractor after the submission and acceptance of Shop Drawings. Shop Drawing information will be used by the Contract Administrator to calculate the appropriate settings.

3.16 Training

.1 Provide training of City personnel in all aspects of maintenance, operation, and functionality for all systems.

.2 Training shall be performed at the NEWPCC Facility in Winnipeg, Manitoba. Training shall involve both classroom style of training, as well as practical training with the equipment present.

END OF SECTION

HIGH VOLTAGE CABLES

1. GENERAL

1.1 Submittals

.1 Submit Shop Drawings for products and accessories.

.2 Submit samples of conductors, when requested by Contract Administrator.

2. PRODUCTS

2.1 General

.1 Use armored type High Voltage (HV) TECK cables for 5 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 plus 90°C, and installation at temperatures down to -40°C. Wires and cables shall meet the applicable CSA standard for construction and testing.

.4 Insulation voltage rating: 5 kV cable shall be rated to a minimum of 8 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 Restriction of Hazardous Substances (RoHS) Compliant.

.4 Meets CSA cold bend test at -40°C.

.5 Meets CSA cold impact test at -40°C.

2.2 High Voltage Concentric Neutral Cables

.1 Nexans "Energex-CN", CSA. approved, 133/100% insulation level, cross-linked polyethylene, 90°C (194°F) rated, concentric neutral power cables designed, constructed and belt tested in accordance with CAN/CSA C68.5 - Primary Shielded and Concentric Neutral Cable for Distribution Utilities. Cable to be as follows:

.1 Nominal voltage rating – 5 kV system;

.2 Conductor material – copper;

.3 Conductor size – as shown on Drawings, with 100% neutral;

.4 Stranding – compact round;

.5 Conductor shield – extruded semi-conducting crosslinked polyolefin;

.6 Insulation – unfilled tree-retardant crosslinked polyethylene;

.7 Insulation shield – semi-conducting crosslinked polyolefin;

.8 Concentric neutral – helically wound tinned copper conductors;

.9 Outer jacket – polyethylene;

.10 Terminators – 3M cold shrink type terminators as approved by local authorities for application; refer to cable termination article in this Section.

.2 Cables to be lead free and RoHS compliant.

.3 Shielded cables to be designed and constructed to safely withstand a ground fault current without damage for eight (8) cycles with an available shield fault of 20,000 amperes. Confirm current rating using manufacturer’s design calculations and standards, and revise withstand rating to suit, if necessary. Notify Contract Administrator of any changes.

.4 Cabling to be rated for operations from 90°C (194°F) to -40°C (-40°F). Cable outer jacket to be of manufacturer’s standard colour. Identify exposed cable with orange colour tape bands every 3 m (10'). Review exact colour scheme with Contract Administrator.

.5 Each cable to be continuous with no splices.

.6 Provide cable connectors and lugs as recommended by cable manufacturers, to suit application and match connection provisions of connected equipment.

.7 Verify with local utility that cable provided is acceptable for connection to their system.

.8 Perform field voltage testing as per cable manufacturer’s instructions.

.9 Acceptable manufacturers are:

.1 Nexans;

.2 Prysmian Cables (Pirelli);

.3 General Cable;

.4 Aetna Cables;

.5 Kerite Company;

.6 Texcan.

.7 Or approved equal.

2.3 High Voltage Power Cables

.1 Nexans, "Energex-SP", CSA approved, 133/100% insulation level, cross linked polyethylene, 90°C (194°F) rated cables designed, constructed and belt tested in accordance with CAN/CSA C68.5 - Primary Shielded and Concentric Neutral Cable for Distribution Utilities. Cable to be as follows:

.1 Nominal voltage rating 5 kV system;

.2 Conductor material - copper;

.3 Conductor size - as shown on Drawings;

.4 Stranding - compact round;

.5 Conductor shield - extruded semi-conducting crosslinked polyolefin;

.6 Insulation shield - semi-conducting crosslinked polyolefin;

.7 Metallic shielding - copper tapes;

.8 Insulation - unfilled crosslinked polyethylene;

.9 Outer jacket - PVC;

.10 Separate insulated grounding conductor - as required;

.11 Terminators – 3M cold shrink type terminators as approved by local authorities for application; refer to cable termination article in this Section.

.2 Cables to be lead free and RoHS compliant.

.3 Shielded cables to be designed and constructed to safely withstand a ground fault current without damage for eight (8) cycles with an available shield fault of 20,000 amperes. Confirm current rating using manufacturer’s design calculations and standards, and revise withstand rating to suit, if necessary. Notify Contract Administrator of any changes.

.4 Polyethylene coverings and outer jackets to be rated for -40°C (-40°F). high voltage cable outer jacket to be of manufacturer’s standard colour. Identify exposed cable with orange colour tape bands every 3 m (10'). Review exact colour scheme with Contract Administrator.

.5 Each cable to be continuous with no splices.

.6 Provide cable connectors and lugs as recommended by cable manufacturers, to suit application and match connection provisions of connected equipment.

.7 Verify with local utility that cable provided is acceptable for connection to their system.

.8 Acceptable manufacturers are:

.1 Nexans;

.2 Prysmian Cables (Pirelli);

.3 General Cable;

.4 Aetna Cables;

.5 Kerite Company;

.6 Texcan.

.7 Or approve equal.

2.4 High Voltage Teck Cables

.1 Nexans, "Firex II Teck" armoured power cables as follows:

.1 Certified to CSA C22.2 No.131, type Teck Cable, up to 5 kV;

.2 Certified to CSA C68.3, for 8 kV and greater;

.3 Certified to CSA C22.2 No.174;

.4 Certified CSA FT1 and FT4, to suit specific application and code requirements;

.5 Nominal voltage rating 5 kV system;

.6 Conductor size - as shown on Drawings;

.7 Conductor: bare, Soft drawn, Class B Compact or Compressed Stranded Copper conductors per ASTM;

.8 Bonding conductor: Class B stranded soft bare copper;

.9 Inner jacket: 90°C (194°F) rated, low-acid-gas-emitting fire-retardant PVC jacket tightly applied over assembly, to prevent slipping of core in a vertical position;

.10 Armour: flexible interlocked aluminum armour, over inner jacket for mechanical protection;

.11 Outer jacket: overall low-acid-gas-emitting fire-retardant PVC jacket rated -40°C;

.12 Lead free and RoHS compliant;

.13 Unshielded;

.14 Insulation shield: chemically cross-linked thermosetting polyethylene (XLPE).

.2 Each cable to be continuous with no splices.

.3 Cable outer jacket to be of manufacturer's standard colour. Identify exposed cable with orange colour type bands every 3 m (10'). Review exact colour scheme with Contract Administrator.

.4 Provide cable connectors and lugs as recommended by cable manufacturers, to suit application and match connection provisions of connected equipment.

.5 Verify with local utility that cable provided is acceptable for connection to their system.

.6 Acceptable manufacturers are:

.1 Nexans;

.2 Prysmian Cables (Pirelli);

.3 General Cable;

.4 Aetna Cables;

.5 Kerite Company;

.6 Texcan.

.7 Or approval equal.

2.5 Conductor Pulling Lubricant

.1 IDI Electric (Canada) Ltd., "Ideal Yellow 77" or "Wire Lube" as required.

2.6 High Voltage Cable Terminations

.1 3M Company, cold shrink QT-III silicone rubber termination kits as follows:

.1 CSA approved;

.2 Meets requirements of IEEE standard 48-1996 with voltage ratings of 5, 8.7, 15, 25/28 or 34.5 kV;

.3 Maximum continuous operating temperature rating of 105°C (221°F), with an emergency overload rating of 140°C (284°F);

.4 Pre-stretched cold shrink design with removable core; when core removed, product shrinks to provide tight seal, without application of heat source;

.5 Capacitive termination stress control constructed of Hi-K stress control compound and Hi-K EPDM rubber tube;

.6 Termination insulator of a skirted or tubular design, constructed of tracking resistant silicone rubber with enhanced water repelling action; skirted for outdoor applications;

.7 Accommodate jacketed concentric neutral, concentric neutral or tape shield cables;

.8 Additionally, include required compression lugs of type compatible with cable type and vinyl electrical tape.

.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 3M Company;

.2 Tyco Raychem;

.3 Prysmian Cables.

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 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 High Voltage Cables

.1 Utilize one of listed pre-qualified 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. Provide cables as specified.

.2 Unless otherwise noted, install underground cables in ducts. Prior to insertion of cable in duct, clean duct by pulling mandrel through entire length.

.3 Where cables are identified to be run in cable tray or using cable racks, provide required cable tray or rack and secure to wall/ceiling structure in accordance with respective product manufacturers' recommendations. Generally, within equipment rooms, install cables within cable tray. 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 high voltage DC test of cables before putting into service. Do not exceed manufacturer's recommended test voltage or duration. Perform acceptance testing in accordance with manufacturer's recommendations. Additionally, refer to testing and verification requirements in Section entitled Electrical Work Analysis and Testing and include applicable requirements.

3.4 Colour Coding and Tagging

.1 Colour code all power distribution conductors at both ends throughout Facility.

.2 Same colour for same phase throughout, by insulation colour markers.

.3 Conductor colour 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.

END OF SECTION

WIRE AND BOX CONNECTORS (0-1000 V)

1. GENERAL

1.1 Section Includes

.1 Materials and installation for wire and box connectors.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No.18.3, Conduit, Tubing, and Cable Fittings, and Update No. 1.

.2 CSA C22.2 No.18.4, Hardware for the Support of Conduit, Tubing, and Cable.

.3 CSA C22.2 No.18.5, Positioning Devices.

.4 CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.5 CSA C22.2 No.65, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).

.2 National Electrical Manufacturers Association (NEMA):

.1 C119.4 Connectors for Use between Aluminum-to-Aluminum and Aluminum-to-Copper, and Copper-to-Copper.

.3 Electrical and Electronic Manufacturer's Association of Canada (EEMAC):

.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

1.3 Action and Informational Submittals

.1 Submit in accordance with Division 1 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.4 Closeout Submittals

.1 Submit in accordance with Division 1 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Division 1 - 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 the floor indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect wire and box connectors from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Materials

.1 Service and Power Feeder Cables:

.1 Compression type terminations for copper incoming power service cables. Utility approved compression type connectors at transformer, for installation by utility.

.2 Compression type terminations for all feeder connections.

.2 Splicing only to be performed inside of suitable rated boxes.

.1 General locations: Fixture type splicing connectors (Marette twist on) to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.2 Wet Locations or Underground: Use CSA splice kits suitable for direct burial to ensure moisture seal.

.3 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CSA-C22.2 No.18.3, 18.4 and 18.5.

.1 Provide appropriate terminals or power distribution blocks.

.4 Bushing stud connectors to consist of:

.1 Connector body and stud clamp for stranded round copper conductors.

.2 Clamp for stranded round copper conductors.

.3 Stud clamp bolts.

.4 Bolts for copper conductors.

3. EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate existing or previously installed under other Sections or Contracts are acceptable for wire and box connector's installation in accordance with manufacturer's written instructions.

.1 Inform contract administrator of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 Installation

.1 Remove insulation carefully from ends of conductors and:

.1 For Compression Type:

.1 Install all compression terminations and connectors using purpose made mechanical tool.

.2 For aluminum compression terminations wire brush conductor end and apply conductive paste (i.e. zinc joint compound) to ends prior to installation of conductors.

.2 For Fixture type splicing connectors (Marette twist on wire nut):

.1 Twist wires together, insert into insulating cap and tighten.

.2 Place a strip of electrical tape over the full circumference of the cap ensuring the gap between the cap and the wires is covered. Firmly press tape in place.

.3 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by Manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65. Installation shall pass tug test, and meet secureness tests in accordance to the manufacturers requirements and CSA.

.4 Install bushing stud connectors per manufacturers requirements, and in accordance with NEMA and EEMAC 1Y-2.

3.3 Cleaning

.1 Progress Cleaning: clean in accordance with Division 1 - 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 Division 1 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from Site and dispose of materials at appropriate facility.

END OF SECTION

1. GENERAL

1.1 Description

.1 This Section of the Specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

.2 Provide all wire and cable requirements for voltage systems 1000 V or less as indicated within this Section.

1.2 References, Codes, Standards

.1 American Society for Testing and Materials (ASTM):

.1 B3, Standard Specification for Soft or Annealed Copper Wire.

.2 B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

.2 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code (CEC), Part 1), Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 0.3, Test Methods for Electrical Wires and Cables.

.3 CSA C22.2 No. 18.3, Conduit, Tubing, and Cable fittings.

.4 CSA C22.2 No. 38, Thermoset-Insulated Wires and Cables.

.5 CSA C22.2 No. 49, Flexible Cords and Cables.

.6 CSA C22.2 No. 51, Armoured Cables.

.7 CSA C22.2 No. 65, Wire connectors.

.8 CSA C22.2 No. 123, Metal sheathed cables.

.9 CSA C22.2 No. 131, Type TECK 90 Cable.

.10 CSA C22.2 No. 174, Cable and cable glands for use in hazardous locations.

.11 CSA C22.2 No. 188, Splicing wire connectors.

.12 CSA C22.2 No. 197, PVC Insulating Tape.

.13 CSA C22.2 No. 208, Fire Alarm and Signal Control.

.14 CSA C22.2 No. 230, Tray Cables.

.15 CSA C22.2 No. 239, Control and Instrumentation Cables.

.3 Insulated Cable Engineers Association (ICEA) requirements where permissible.

.4 Institute of Electrical and Electronics Engineers (IEEE):

.1 383, IEEE Standard for Qualifying Electric Cables and Splices for Nuclear Facilities.

.2 1682, IEEE Standard for Qualifying Fibre Optic Cables, Connections, and Optical Fibre Splices for Use in Safety Systems in Nuclear Power Generating Stations.

.5 Underwriters Laboratories (UL):

.1 514B, Standard for Conduit, Tubing, and Cable Fittings.

1.3 Definitions

.1 Conductor: the current carrying portion of an insulated wire or an uninsulated wire. All conductors shall be stranded copper.

.2 Wire: a single, insulated conductor.

.3 Cables: an assembly of a single or multiple insulated conductors, with overall sheaths or jackets, with or without metallic armour or shielding.

.4 Wiring: describes wires, cables and conduit in a general way.

1.4 Submittals for Review

.1 Submit product data in accordance with Division 1 and Division 26.

.1 Catalogue and technical data.

.2 Installation data including allowable pulling tension, pulling radius, and bending radius.

.2 Submit Cable Schedule when indicated on the Drawings or other Specifications.

1.5 Shipment, Protection and Storage

.1 Ship, protect and store equipment as required by Division 26.

2. PRODUCTS

2.1 General

.1 Where manufacturer or series is specified, these are provided for the purpose of establishing the grade of quality for the materials specified in this Section and are taken from one (1) manufacturer's product line. Unless otherwise noted, products from other listed manufacturers which have identical features and characteristics are acceptable.

.2 Refer to the other Division 26 Specifications for acceptable cable and wire connectors.

.3 To prevent corrosion due in Hazardous locations that can have Group IIB gases present (i.e. H_2S), steel armor, steel conduit, and steel cable supports are generally not permitted. Utilize aluminum materials to prevent corrosion.

.4 All conductors (including grounds and bonds) to be high conductivity copper.

.5 Materials to be manufactured to Canadian CSA standards, approved and suitable for -40°C to +90°C operation. Wires and cables shall meet their applicable CSA standard for construction and for testing.

.6 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.

.1 Space out conductors and separate different systems and voltages in accordance with the CEC and the City of Winnipeg requirements.

.7 Outdoor applications: Manufacturer literature shall include sunlight resistant, and suitability for direct burial.

.8 Acceptable Cable Manufacturer: Nexans, General Cable, Southwire.

2.2 Fastenings and Supports

.1 Design wire and cable anchorage and support system for vertical and lateral loading in accordance with the Manitoba Building Code (MBC).

.2 One whole malleable iron, steel, aluminum, zinc straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.3 Channel type or cable tray supports for two (2) or more cables.

.4 Threaded rods: minimum 6 mm diameter to support suspended channels, increase size as required for the loads.

2.3 Wire Insulation Voltage

.1 The minimum wire insulation ratings as provided below is in general, and pending the mean and methods employed as part of the installation work. For example, barriers will be required in cable tray where insulation ratings are not the same, between power and control cabling systems, or between noisy cabling systems.

.1 Wiring at 50 V and less shall be a minimum of 300 V insulated.

.2 Wiring at 300 V and less shall be a minimum of 600 V insulated.

.3 Wiring at greater than 300 V:

.1 Shall be a minimum of 1000 V insulated when feeding equipment that can branch to multiple loads. Feed cabling to services, MCC's, distribution panelboards, distribution transformers etc. are generally 1000 V rated.

.2 Between a 600 V VFD and motor shall be a minimum of 2500 V insulated, and VFD/inverter rated.

.3 Shall be a minimum of 600 V insulated otherwise.

.2 Composite 600 V power and 120 V control cables will not be permitted on this project.

2.4 Insulated Ground Conductors

.1 Insulated copper ground conductors:

.1 Size: as indicated on the Drawings, but in no case smaller than CEC required sizes.

.2 Type: soft drawn, stranded, flexible, high conductivity.

.1 Use tinned-coated in corrosive/hazardous environments including when buried in earth, or embedded in concrete.

.3 Shall meet the requirements of ASTM B8.

.4 Insulation: chemically cross-linked thermosetting polyethylene (XLPE) material, rated RWU90

.5 Flame Test Rating:

.1 CSA FT4 (if exposed).

.2 CSA FT1 (if entirely within conduit).

.6 Insulation voltage rating: 600 V.

.7 Colour: green or green with yellow stripes as indicated on the Drawings.

2.5 Bare Ground Conductors

.1 Bare copper ground conductors:

.1 Size: as indicated on the Drawings, but in no case smaller than CEC required sizes.

.2 Type: soft drawn, stranded, flexible, high conductivity.

.1 Use tinned-coated in corrosive/hazardous environments including when buried in earth, or embedded in concrete.

.3 Shall meet the requirements of ASTM B8.

.2 Refer to the Drawings and other grounding specifications for additional application and other requirements.

2.6 Building Wires

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE. RWU90 XLPE for grounding pigtails.

.3 Wires sized 2 AWG and smaller to be factory colour coded, taping will not be accepted.

2.7 Single Conductor Wire(s) in Conduit

.1 Insulation chemically cross-linked, thermosetting polyethylene, and, unless otherwise specified, rated RWU90, 1000 V. Use RWU90 insulation where specified, or in conduit systems in wet locations including below grade.

.2 Ensure conduit is dry and clean prior to pulling conductors in. If moisture is present, thoroughly dry and clean conduits.

.3 Use pulling lubricant when pulling conductors in conduit to reduce the strain on the wires. Lubricants must be polymer based and must not adversely affect or degrade cable insulation.

.4 Do not combine conductors in a common duct or conduit without regard for de-rating.

.5 Conductors, unless otherwise shown or specified:

.1 Stranded copper.

.2 Minimum size No. 12 AWG, for control signals No. 14 AWG may be provided.

.6 Colour coding and labeling per Division 26 requirements; wires sized No. 2 AWG and smaller to be factory-coded, taping will not be accepted.

2.8 Teck 90 Cable

.1 Cable and Colour Coding in accordance with Division 26 - Common Work Results - Electrical.

.1 Conductors and insulation same as for Building Wires, except that manufacturer's standard insulation colour coding for multi-conductor cabling is acceptable.

.2 Shall be installed in industrial, hazardous, underground, or wet areas and where noted on the Drawings and cable schedules.

.3 Where surface mounted, cables shall be securely supported using aluminum cable clamps and cabling support systems. Space supports a maximum of 1 m apart.

.4 Where multiple cables are run into an area, install cables on cable tray or on cabling support hangers.

.5 Cable consists of multi-conductor, composite, or single-conductor construction as shown on the drawings or as specified, plus grounding conductor, with interlocking aluminum armour and outer jacket.

.1 Outer jacket of thermoplastic polyvinyl chloride (PVC) material with low gas emissions, rated minus (-) 40°C, with flame test rating as required by building code.

.2 FT4 flame test requirements when installed in buildings of non-combustible and combustible construction. Refer to CEC Rule 2-130 and the National Building Code of Canada Article 3.6.4.3 for further information and requirements.

.3 FT6 flame test requirements when installed in spaces between a ceiling and floor, or ceiling and roof, that may be used as a plenum in buildings of combustible or non-combustible construction. Refer to CEC Rule 2-130 and the National Building Code of Canada Article 3.6.4.3 for further information and requirements.

.6 Minimum bend radius is 12 times, or larger as required by the cable Manufacturer.

.7 Hazardous Locations: Cable shall come with “HL” rating for hazardous locations in Zone 1 or Zone 2 areas.

.8 Conductors:

.1 Inner jacket thermosetting polyvinyl chloride (PVC) compound.

.2 Grounding conductor: copper.

.3 Circuit conductors: copper, size as indicated.

.9 Insulation:

.1 Outer jacket: chemically Cross-linked polyethylene XLPE type RW90.

.2 Inner jacket: polyvinyl chloride (PVC), 600V or 1000V (as applicable), 100% insulation level.

.3 Voltage Rating: as required for the application/installation.

.10 Avoid damaging outer jacket covering the armor. In some areas, such as the chemical building, exposed armor is not desirable. Replace cables at no additional cost where outer jacket is damaged.

2.9 VFD Cable (Drive Rated Cable)

.1 A PVC outer jacket rated CSA C22.2 No. 0.3 FT4 and AG14 to ensure the cable is grounded at the terminations only, preventing the pick-up of stray currents. The black PVC jacket shall be UV resistant, suitable for outdoor use, and “HL” rated where required.

.2 Connector: Low impedance rated connector, refer to the connectors section within this specification for additional requirements.

.3 Conductors:

.1 Three (3) copper-conductors cable with three symmetrically positioned bonding conductors, size as shown or specified.

.2 Grounding conductors: Three soft bare copper, symmetrically located in continuous contact with the copper tape shield or continuous aluminum armour.

.3 Circuit conductors: copper, size as indicated.

.4 Armoured cable type:

.1 The continuously corrugated, corrosion-resistant aluminum sheath with 100% coverage and low resistance path to ground.

.1 Designed to reduce high frequency noise interference with data and control signals.

.2 Cross-linked polyethylene (XLPE) RW90 insulation on main conductors which guarantees high dielectric strength to withstand high voltage spikes of 2 to 3 times normal voltage. Longer cabling systems will require higher withstand capacities.

.3 Shield: Continuous copper tape shield with 50% overlap or continuous (non-interlocked) aluminum armour.

.4 Approved for six-pulse VFD use.

.5 Non-Armoured cable type:

.1 Conductors:

.1 Grounding conductors: Three soft bare copper, symmetrically located in continuous contact with the copper tape shield or continuous aluminum armour.

.2 Circuit conductors: copper, size as indicated.

.2 Cable for VFD application:

.1 Designed to reduce high frequency noise interference with data and control signals.

.2 Three bonding conductors – soft bare copper.

.3 Cross-linked polyethylene (XLPE), RW90 insulation on main conductors.

.4 Overall PVC outer jacket rated FT4.

.5 Shield: Continuous copper tape shield with minimum 50% overlap.

.6 Approved for six-pulse VFD use.

.3 All non-armoured VFD cables shall be run in conduit.

.6 Acceptable Manufacturers: Nexans DriveRx, Lapp Olflex, Belden VFD, or approved equal in accordance with the tender documents.

2.10 Instrumentation and Control Cables

.1 Armoured Control and Instrumentation Cable (ACIC) and Control and Instrumentation Cable (CIC) to: CAN/CSA-C22.2 No. 239.

.1 Armoured control and instrumentation cable (ACIC), to have aluminum, interlocked armour with overall PVC jacket. ACIC cable may be installed in cable tray, provided that:

.1 The cable tray does not contain power cables or at the very least a tray-rated barrier has been installed providing physical separation. When tray-rated barriers have been installed maintain separation between power and instrument/control systems.

.2 The ACIC cable voltage rating is equal to or greater than the highest voltage contained in the cable tray.

.2 Install Instrumentation Cable (CIC) in conduit, this cable may not be installed in cable tray. Protection in conduit is required over the entire length.

.2 Conductors: minimum size, #16 AWG, stranded, annealed (7 strand minimum), tinned copper, unless otherwise specifically noted on the Drawings.

.3 Insulation: chemically cross-linked thermosetting polyethylene (XLPE), rated type RW90, 300V.

.4 Conductor identification: Each grouping (pair, triplet, quad) by consecutive number coding, permanently marked at regular intervals.

.5 Construction: twisted pair, triplet, and quad grouping with staggered lay.

.6 Shielding shall be in conformance with:

.1 Minimum 100% coverage aluminum foil or mylar tape shield with minimum 25% overlap.

.2 Separate drain wire, minimum size 18 AWG, bare, stranded tinned copper. Drain wire to be in direct, continuous contact with the shield.

.3 One or more twisted shielded pairs as indicated.

.4 Shield drain wires, at the ungrounded end, are to be taped back to the cable. Do not cut the shield drain wire off.

.7 Jacket: PVC (-40 °C to +90 °C), low acid gas, minimum FT4 rated flame spread.

.8 Termination fittings: Type, configuration and gender required to connect cable directly to equipment without additional adapters or fittings.

2.11 Fire Alarm Cables

.1 Refer to the drawings and fire alarm specifications for additional requirements.

.2 Low energy, 300 V, FAS 105 shielded cable: minimum #16AWG, with PVC insulation.

.3 Overall aluminum /polyester foil shield, with tinned copper drain wire.

.1 Shields to be grounded at one end only (source end).

.4 All fire alarm cables shall be installed in a separate, dedicated conduit system.

.1 Install conductors to be entirely independent of all other wiring. Do not enter raceway, boxes or enclosures occupied by other wiring except where necessary to connect to power supply, communication circuit, or ancillary devices.

.5 For data communication link A (DCLA) fire alarm circuits, install primary wiring circuit and alternate wiring circuit in separate conduit having a minimum separation of:

.1 300 mm when installed vertically.

.2 1200 mm when installed horizontally.

.6 For data communication link A (DCLA) fire alarm circuits, the primary wiring circuit and alternate wiring circuit may share the same conduit:

.1 For a distance of less than 3000 mm where the primary and return conductors enter or exit field devices, control unit or transponder enclosures.

.2 For single conduit drops to individual field devices.

.3 For single conduit drops to multiple field devices installed in a single room not exceeding 100 m².

2.12 Flexible and Portable Cables

.1 Designations and Compliance:

.1 Flexible Cords; Type SOW, to CSA C22.2 No. 49, Type ST, to CSA C22.2 No. 49.

.2 Portable Cables up to No. 2 AWG, Type SGOW, to CSA C22.2 No. 96.

.3 Portable Power Cables up to 500 kcmil, Type G, to ICEA S-68-516.

.2 Type SOOW, flexible, extra hard usage conductor, watertight, rubber EPDM insulation, with CPE oil resistant outer covering and incorporated ground conductor, 90°C rated.

.3 Flexible, non-armored cables to be installed where plug / cord assemblies are specified and required.

.4 Flexible festoon cables to be installed where specifically required for mobile equipment. Terminate both ends of festoon cables, providing cable strain relief.

.5 Instrumentation and control flexible cables, to have braided flexible shield, minimum size 16 AWG.

.6 Conductors and Insulation:

.1 Stranded.

.2 Size as shown or specified.

.3 Insulation and conductor arrangement as determined by governing standard.

2.13 Mineral Insulated Cables

.1 Install cable securely supported by straps and hangers.

.2 Support 2-hour fire rated cable a minimum of every 1-meter interval (or less).

.3 Make cable terminations by using cable Facility approved termination kits. Termination must be performed by personnel specifically trained by the equipment Facility.

2.14 Ethernet and Fibre Cables

.1 Cable and Colour Coding in accordance with Division 26 - Common Work Results - Electrical.

.2 Minimum bend radius is 15 times, or larger as required by the cable Manufacturer.

.3 Cable consists of multi-pair or single-pair as shown on the Drawings or specified, with interlocking aluminum armour and outer jacket.

.1 Ethernet cabling: Shielded twisted-pair with a minimum speed of Category 6 (CAT6).

.2 Fibre optic cabling - Indoor: with a minimum speed of OM3.

.4 Refer to Teck 90 Cable (Part 2.5 of this Specification) for:

.1 Voltage Rating.

.2 Flame Test Rating.

.3 Hazardous Locations.

.4 Outer jacket.

2.15 Connectors for Armored Cables

.1 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.

.2 All connectors be watertight, approved for TECK cable. All connectors shall be packed with Liquid-type sealing compound (includes pouch of sealing compound with integral spout and fibre damming material. Putty-type sealing compound may also be used except for shielded cable applications. Watertight type shall include:

.1 An elastomeric bevelled bushing.

.2 A funnel entry, splined gland nut.

.3 A non-magnetic, stainless steel grounding device with dual grounding action.

.4 A taper threaded hub.

.5 A hexagonal body and gland nut.

.3 Integral seal type with metal-to-metal contact construction.

.4 Sealing of multi-conductor cable shall be accomplished with a liquid-type polyurethane compound.

.5 VFD requirements:

.1 Applies to all cabling in between the VFD and motor.

.2 A low impedance rated connector, with ratings required for the environment it is installed. Two tests shall be performed to demonstrate low impedance, mainly:

.1 The fitting is installed on the cable and screwed into an enclosure, then the resistance between the cable armor and enclosure is measured, the result can be no more than 50 mV. Refer to UL514B for typical testing setup.

.2 A pull test is then conducted and the test above is repeated a second time.

.6 Wet and Ordinary location: Regular TECK connector.

.7 Corrosive location: TECK Connector made of chemically resistive materials, or sealed and covered with Thomas & Betts (ABB) Shrink-Kon, heavy wall, heat-shrinkable protective tubing.

.8 Hazardous Locations:

.1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.

.2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding, or the explosion proof seal.

.3 Includes hazardous ratings sufficient for the Zone for which it is installed. TECK Connector made of chemically resistive materials, or sealed and covered with Thomas & Betts (ABB) Shirnk-Kon, heavy wall, heat-shrinkable protective tubing.

.9 Approved products:

.1 Teck Cable, (Non-Hazardous Locations):

.1 Approved Manufacturers: ABB (Thomas & Betts) or Eaton (Cooper Crouse-Hinds).

.2 Thomas & Betts Star® Teck ST series, aluminum.

.2 Teck Cable, (Hazardous Locations):

.1 Shall meet the requirements of CSA C22.2 No. 174 and be marked accordingly.

.2 Approved Manufacturers: ABB (Thomas & Betts) or Eaton (Cooper Crouse-Hinds).

.1 Thomas & Betts, Star® Teck XP (STX) series, explosion proof aluminum, CSA certified Class I, Divisions 1 and 2, Groups A, B, C, D.

2.16 Strain Relief Connectors

.1 Watertight type for use with flexible cables.

.2 Material compatible with connecting body such as junction, outlet or splice box to which connection is made.

.3 Stainless steel wire mesh cord grip where connector is used with free-hanging cable.

.4 Typical Products: Thomas & Betts Type RANGER.

2.17 Wire Connectors

.1 The following listings specify products for copper conductors only. Aluminum conductors are not foreseen for this project. In the event that aluminum conductors are specifically approved by the Contract Administrator, it is the Contractor's responsibility to select the appropriate connector, using the following specifications as the guideline.

.2 Twist-On Connectors:

.1 Insulated serrated or wing-type cap.

.2 Internal spiral spring; set-screw or crimp-type not acceptable.

.3 Minimum rating 600 V.

.4 Limited for use up to No. 10 AWG wire.

.3 Terminal Connectors:

.1 Ring-type or locking fork-type, crimp-on terminal with nylon insulating sleeve over brazed seam shank.

.2 Minimum rating 600 V, 105°C.

.3 Conductive member made from electro tin-plated copper.

.4 Use limited for conductors up to No. 10 AWG.

.4 Compression Lugs:

.1 Made from one-piece pure electrolytic copper tubing, tin plated.

.2 Colour coded or marked with manufacturer's die index.

.3 Long barrel for minimum two (2) crimps.

.4 For use with conductors No. 8 AWG and larger.

.5 For No. 1/0 AWG and larger conductors, use two-hole long barrel compression lugs wherever possible.

.6 Install ferrules with nylon insulating sleeves on all No. 14 AWG and smaller stranded wires being terminated on terminal strips. Individual ferrule is required for each conductor.

.5 Compression splices: similar to compression lugs, suitable for in-line, C-tap and similar configurations.

2.18 Joint Compound

.1 Conductive compound, suitable for application to threaded and compression connections.

.2 Compatible with cable and conductor insulation and material.

.3 Capable of being brushed on at temperatures from minus (-) 25°C to (+) 110°C.

.4 Typical products, within the limitations outlined:

.1 Aluma-Shield.

.2 Burndy Penetrox.

.3 Thomas & Betts Kopr-Shield.

2.19 Electrical Tape

.1 To be compatible with conductor or cable insulation or jacketing, as applicable.

.2 For general purpose (indoors): vinyl plastic (PVC insulating), premium grade, minimum 0.18 mm (7 mil) thickness, black or colour coded, as required. The tape is intended to be applied in layers, each layer being half-lapped. Typical product: 3M Super 33+ or 35.

.1 Where tape is used for identification of conductors at a supply connection point or similar location, “Weather Resistance” tape shall be used.

.3 Self-vulcanizing linerless rubber tape, minimum 0.76 mm (30 mil) thickness. Typical product: 3M Type 130 C.

3. EXECUTION

3.1 Coordination

.1 Provide adequate notice to the Contract Administrator so that all cable installations can be inspected prior to connecting equipment.

.2 Coordinate with Division 26 – Electrical System Studies.

.1 Provide complete run lengths for all power cables from Equipment “A” to Equipment “B”, and a copy to the Contract Administrator for their records. For each cable run indicate the type of installation method (i.e., cable tray (& spacing), strut hangers, conduit (& type), underground etc.)

.1 Provide cable type (i.e. RW90, Teck90, THWN etc.)

.2 Provide Conductor type (i.e.. Alumimum or Copper).

.3 Provide Number of Conductors in cable, and size of conductors.

.4 Provide Number of Conductors per phase.

3.2 Field Quality Control

.1 Perform tests in accordance with Division 26 - Common Work Results - Electrical.

.2 Perform testing before energizing electrical systems.

.3 Perform megohmmeter testing of all cables (each conductor) for cable sizes 10 AWG and larger - with the following exceptions - megohmmeter testing is not required for: lighting circuit, 120 VAC duplex receptacle cabling. Provide test documentation for all cables tested.

3.3 General Cable Installation

.1 Lay cable in cable trays in accordance with Division 26 - Cable Trays for Electrical Systems.

.2 Terminate cables in accordance with Division 26 - Wire and Box Connectors - (0-1000 V).

.3 Re-use of existing wiring:

.1 Except where specifically identified or approved, reuse of existing wiring is not permitted.

.2 Ensure all existing wiring is tagged prior to disconnection of equipment.

.3 Tag spare wires as “Spare” and indicate the location of the other end of the wire. In addition, correlate / identify both ends of each conductor.

.4 Establish exact location of equipment and their connection points before wiring installation is commenced.

.5 Provide non-ferrous GPO (glastic) or aluminum plates for single conductor cable entry into an enclosure. Aluminum entry plate shall be used where conductor armour is required to be bonded to the enclosure. GPO (glastic) materials shall be used where cable armour is not bonded to the enclosure.

.6 In some cases, the electrical conductor size may be too big to terminate on vendor supplied lugs. In these cases, the Contractor remains responsible for making all cable terminations. The Contractor shall replace the lugs or shall provide reducing compression connectors to make the termination. Alternatively, the Contractor may provide appropriate junction boxes to reduce the conductors’ sizes as required to perform the cable termination.

.7 Do not embed cables or conduits in masonry or concrete without written approval from the Contract Administrator. Wiring through conduit sleeves for short, direct wall or floor penetration is accepted.

.8 Protect wiring against damage from welding spatter and other construction activity by suitable means.

.9 Protect metallic cable connectors in process areas with heat-shrinkage sleeves. Sleeve length to extend 75 mm past the connector and to provide a tight fit around connector and cable.

.10 Arrange wiring in process area such that motor connection boxes and other field mounted devices are entered at the side or bottom of the connection box or enclosure.

.11 Install reducing bushings where threaded entry in a motor connection box is larger than the hub size of the cable connector.

.12 Install wires and cables in a continuous length between termination points. Splices are not permitted, except within junction boxes or where specifically approved by the Contract Administrator. Where splices are necessary and approved utilize the cable Manufacturer approved and recommended kit. In-line splices are not acceptable.

.13 At the discretion of the Contract Administrator damage to a cable jacket may be repaired in accordance with the manufacturer's recommendation. If requested by Contract Administrator, replace the entire length of a damaged cable.

.14 Arrange cable supports such that maintenance work or removal of the equipment served by the cable, will not cause any damage to the cable.

.15 Fire stop completed conduit and cable penetrations at fire rated walls with approved materials.

.16 Provide an approved hazardous location barrier to maintain the hazardous location classification, at the location the conduit or cable penetrates the hazardous location boundary.

.17 Do not pull conductors into conduit or cable tray until rough building construction operations have been completed.

.18 Conduits and cable supports are only to support conduits or cables. Contractor shall not attach pipes, fixtures, and the like to conduit or cable supports.

.19 Conductor length for parallel feeders to be identical.

.20 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.21 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.22 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common/shared neutrals are not permitted.

.23 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

.24 Utilize weatherproofing sealing system appropriate for the area of installation. Install to the manufacturer's recommendations, flush with the exterior of the wall.

.1 Prior to covering up wall penetration work, arrange for a site inspection of the work with the Contract Administrator. Proof of proper installation is required.

.25 For outdoor or exposed installations, make all entries of cables or wires to equipment or panel from the bottom or side to minimize water entry points. Make no entries of cables or wires from the top unless specifically approved by the Contract Administrator.

3.4 Installation of Building Wires

.1 Install wiring as follows:

.1 In conduit systems in accordance with Division 26 - Conduits, Conduit Fastenings and Conduit Fittings, and as indicated on the Drawings.

3.5 Installation of Jacketed Armoured Cable (TECK, VFD rated etc.)

.1 Install on surface. One or two surface mounted cables may be strapped using one-hole aluminum straps with clamp back (Thomas & Betts 1275AL series or equal). Fastening, strapping and support materials shall be compatible with the area conditions. Strap at every 1 m intervals. Cables shall not be strapped to handrails and piping wherever possible.

.2 A group of three (3) or more cables running parallel to each other shall be installed in a cable tray.

.3 Install cable connectors at both ends of each armoured cable.

.4 Provide protection for cables where subject to mechanical damage, notably where cable passes through a floor slab.

.5 Tighten and mark Teck connector gland nuts following tightening. Mark shall be made with felt pen as a line between gland nut surface and surface of connector body to show relative position of gland nut after final tightening has been done.

.6 Where hazardous rated Teck connectors are used, installer shall follow manufacturer's assembly procedures for all stages of the installation. Allow cable sealing compound to harden in connector bodies before inserting connector and wires into connector hub.

.7 Group cables wherever possible on channels.

.8 Installation of VFD cables:

.1 VFD cable to be installed between a variable frequency drive (VFD) and the load which it serves.

.2 Secure using aluminum cable clamps.

.3 Route armored cable on cable tray or strapped to cabling system supports (for short runs only).

.4 Non-armored VFD cable is to be run in conduit.

.5 Metallic armor to be bonded to ground at both ends.

.6 Supply end of the VFD cable to have the bond conductors connected to the VFD drive and connected to ground. Load end of cables to have the bond conductors connected to the motor bond/ground lug.

.7 Wire and connect in accordance with the Facility's recommendations.

.8 Space VFD cable as per the following minimum distances:

.1 From 120/208 V wiring: 300 mm.

.2 From 24 VDC instrumentation and control wiring: 300 mm.

.9 Avoid damaging outer jacket covering the armor. In some areas, such as the chemical building, exposed armor is not desirable. Replace cables at no additional cost where outer jacket is damaged.

.9 In conduit systems in accordance with Division 26 - Conduits, Conduit Fastenings and Conduit Fittings, and as indicated on the Drawings.

.10 In cable tray systems in accordance with Division 26 – Conduits - Conduit Fastenings and Conduit Fittings, and as indicated on the Drawings.

.11 Install cable exposed, securely supported by straps/clamps, secured in spacing intervals as required by the code.

3.6 Installation of Control Cables

.1 Install control cables in conduit, cable troughs, or by direct burial as indicated on the Drawings.

.2 Ground control cable shield.

3.7 Installation of Flexible Cables

.1 Must be installed with strain relief-type connectors to take the tension from the cable termination.

.2 Provide wire mesh grip where cable is free hanging or subject to frequent flexing.

.3 Where excess cabling is to be provided, neatly coil and tie excess length and attach to structure using hooks or supports as specified.

3.8 Connector Sizing

.1 Strictly adhere to manufacturer's listing for matching connector and terminal sizes to cable and conductor sizes.

.2 Similarly, the proper compression tools and dies must be selected for each compression fitting to obtain the correct compression strength and as not to damage insulation sleeves and finishes.

.3 Select cable connectors with correctly sized grommets, bushings, glanding devices and threads. The application of tape or using reducers is not an acceptable alternative to selecting the correct size connector.

3.9 Terminations and Splices

.1 Use locking fork-type connectors on flat screw-type terminals.

.2 Use ring-type connectors for No. 10 AWG and smaller on stud and post-type terminals and any termination subject to vibration.

.1 Twist-on connectors are limited for use on lighting circuits, control wiring in outlet boxes, luminaires, and with factory-supplied leads or pig-tails in field devices. Pre-twist the conductors tightly prior to installation of twist-on connectors. Do not use twist-on connectors inside panels and apparatus which are equipped with terminal blocks.

.2 Splice connectors for equipment pigtail, lighting, and receptacle circuits: For wire sizes #12 and #10 AWG inclusive, twist-on compression spring type. Wing-Nut by Ideal, Marrette Type II by Marr Electric Ltd., or approved equal.

.3 Use compression-type lugs for No. 8 AWG and larger unless equipment is provided with proper lugs designed for conductor terminations.

.1 Equipment pig-tail power circuit connections: For wire sizes #8 AWG minimum, split-bolt type, sized to suit number and size of conductors. SERVIT Type KS by Burndy Inc., or approved equal.

.4 Unless motor connection boxes are equipped with terminals, use compression-type motor connection lugs and machine bolts with belville washers at motors for conductors up to No. 1 AWG. For No. 1/0 AWG and larger conductors use two-hole long barrel compression lugs and apply self-vulcanizing tape or heat-shrink end cap over termination.

.5 In moist or corrosive areas, apply joint compound to conductor prior to installation of compression fitting.

.6 Exercise care in stripping insulation from wire. Do not nick conductors.

.7 Strictly follow manufacturer's instructions with regards to tool size and application methods of terminations and compounds.

3.10 Accessories

.1 Cable grips: To accommodate type and geometry of cable supported, single weave, variable mesh design, by ABB (Thomas and Betts), Eaton (Crouse Hinds), or approved equal.

3.11 Colour Coding

.1 See Division 26 - Common Work Results - Electrical for additional requirements, and City of Winnipeg standards.

.2 Colour code all power distribution and control conductors at both ends throughout Facility.

.3 Same colour for same phase throughout, by insulation colour or permanently applied colour banding at all distribution centres, panels and outlet boxes.

.4 Colour tape shall be vinyl, 19 mm wide.

.5 Conductor Colour coding to be in accordance with CEC and as follows:

Conductor	**Colour**
Equipment Grounding Conductor	Green
Neutral Conductor	White
1 Phase, 3 Wire	Red, Black, White
3 Phase	Red (Phase 1), Black (Phase 2), Blue (Phase 3)
DC (Positive), 3 Wire	Red
DC (Negative), 3 Wire	Black
DC (Ground), 3 Wire	White or Gray

3.12 Cable Identification Tags

.1 See Division 26 - Common Work Results - Electrical for additional requirements.

.2 Sleeve: Permanent, PVC, white, with legible machine-printed black markings.

.1 Manufacturer and Product: Raychem; Type D-SCE or ZH-SCE.

.3 Heat Bond Marker:

.1 Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.

.2 Self-laminating protective shield over text.

.3 Machine printed black text.

.4 Manufacturer and Product: 3M Co.; SCS-HB.

.4 Marker Plate: Nylon, with legible designations permanently hot stamped on plate.

.5 Tie-On Cable Marker Tags:

.1 Chemical resistant white tag.

.2 Size: 13 mm by 51 mm.

.3 Manufacturer and Product: Raychem; Type CM-SCE.

.6 Grounding Conductor: Permanent green heat-shrink sleeve, 51 mm minimum.

.7 Cable Ties:

.1 Nylon, adjustable, self-locking.

.2 Use nylon cable ties only in horizontal cable tray runs to secure cables to the tray. Nylon cable ties are not to be used for cable support.

.3 Manufacturer and Product: Thomas & Betts Ty-Rap.

.8 All 120/208V power cables require a tag. If tag is not indicated on Drawings, request tag from Contractor Administrator.

.9 Use wire markers in terminating all wiring, including but not limited to power, control, signal, communication, and lighting wiring.

.10 Identify all multi-conductor cables at all termination points with wire markers. In addition to identifying the cable, identify each of the individual conductors at all termination points, unless it is a colour-coded power conductor. All cable markers must be readily visible when the device cover is open.

.11 All control conductors shall have wire numbers at both ends of each wire using Brady heat shrink sleeves with typewritten wire numbers. Wire markers shall have a white background and black lettering. Handwritten tags on adhesive tape is not acceptable. The Contractor shall adhere to the tagging scheme shown on the control Drawings.

.1 Heat shrink insulation shall be used where additional insulation or dressing of connected cables is required. Electrical tape shall not be used for additional insulation or dressing of connected cables. The use of heat shrink tubing and electric heat gun to heat the shrink tubing is the required method.

.1 Thermally stabilized, crosslinked polyolefin.

.2 Manufacturer and Product: Thomas & Betts Shrink-Kon. or approved equal.

3.13 Cable Tagging

.1 Cables shall be identified as require by the City of Winnipeg – Water & Waste Department Identification Standard.

3.14 Testing

.1 As required under Division 26, other divisions, by manufacturers, and by vendors.

.2 See Division 26 - Common Work Results - Electrical for additional requirements.

.3 See Division 26 – Commissioning of Electrical Systems for additional requirements.

END OF SECTION

1. GENERAL

1.1 Description

.1 Modify the existing ground grid to provide a complete permanent, continuous grounding system to include new equipment provided in this Contract. Securely and adequately ground all components of the electrical system in accordance with the requirements of all related sections in the latest Canadian Electrical Code, Local Building Code, the local Electrical Inspection Branch, and the Contract Documents.

.2 Provide a single, complete, integrated grounding system, including conductors, raceways, and connections, indicated and specified, and in accordance with the CSA. The system is to consist of cables, supports, and all necessary materials and inter-connections to provide a complete system. Measured resistance to ground of the network shall not exceed 5 ohms.

.3 Install grounding connections to typical equipment included in, but not necessarily limited to following list:. Switchgear, motor control centers (MCC), electric equipment enclosures, outdoor substations, transformers, switch structures, frames of motors, duct systems, control panels, distribution panels, outdoor lighting etc.; ground grid systems with ground rod and water pipe connections; structural steel (building steel work), and lightning protection system.

.4 Include grounding conductors completely inter-connecting ground rods, ground grid, substation, switchgear and motor control center ground buses, other distribution equipment, and other groundable equipment.

1.2 References

.1 ASTM International (ASTM):

.1 B3, Standard Specification for Soft or Annealed Copper Wire.

.2 B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

.3 B33, Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

.2 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, and Update No. 1.

.2 CSA C22.3 No. 3, Electrical Coordination.

.3 CSA C22.2 No. 27, Busways (Tri-national standard with UL-857 and NMX-J-148-ANCE).

.4 CSA B72, Installation code for lightning protection systems.

.3 Institute of Electrical and Electronics Engineers (IEEE):

.1 IEEE 80, Guide for Safety in AC Substation Grounding.

.2 IEEE 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

.3 IEEE 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems.

.4 IEEE 399, Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book).

.5 IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

.4 National Fire Protection Association (NFPA):

.1 780, Lightning Protection Code.

.5 Underwriters Laboratories (UL):

.1 467, Standard for Grounding and Bonding Equipment.

1.3 Action and Informational Submittals

.1 Submit Shop Drawings and manufacturers' product data in accordance with requirements of Division 1 and Division 26.

.2 All hardware shall bear either CSA or cUL approvals.

.3 Submit catalog and dimensional data for the following:

.1 Ground rods.

.2 Connecting hardware.

.3 Product Data: Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.4 Submit all ground continuity and all ground resistance system test results.

2. PRODUCTS

2.1 Manufacturer's Compliance

.1 Manufacturer's acceptance contingent upon products' compliance with the Specifications.

.2 Manufacturers adherence to the Canadian Electrical Code and UL Standard 467.

2.2 Grounding Conductors

.1 Provide copper grounding conductors bare or insulated, sized as indicated. When not indicated on the Drawing provide in accordance with CSA. Provide protection of conductors in locations where physical damage would result from direct exposure.

.1 Grounding and bonding conductors for substations, main panels and distribution points, and ground rod connections shall be annealed copper type conforming to ASTM B3, stranded, with 98% conductivity.

.2 Unless noted otherwise, all conductors No. 8 AWG and larger shall be stranded, Class B in accordance with ASTM B8.

.1 Uninsulated conductors shall be bare copper in accordance with ASTM B3 for soft annealed copper (CU), tinned in accordance with ASTM B33.

.2 Use tinned-coated in corrosive/hazardous environments including when buried in earth, or embedded in concrete.

.2 Equipment and Facility bonding where portions of the underground installation are in RPVC conduit only: use green jacketed RWU90 XLPE, copper, size as indicated.

.1 Equipment ground conductors run with circuit conductors and grounding electrode conductor shall be 600 V with green insulation, unless noted otherwise on the Contract Documents.

.3 Portions of the installation are above ground with connection to the underground grounding system: Installations in vertical RPVC conduit with connection to the underground grounding system: use green jacketed RWU90 XLPE, copper, size as indicated.

.1 Conductors: PVC insulated coloured green, stranded soft annealed copper wire No. 10 AWG for grounding meter and relay cases.

.4 Grounding Conductor Electrode: All other portions of underground and/or exterior installations shall be direct burial in contact with bare earth: bare copper, size as indicated.

.1 Conductors: bare, stranded, 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, motors, ground connections etc.

.5 Interior Facility (cable trays, conduits, interconnections between switchgears/MCCs etc.) for above grade connections only.

.1 Ordinary Location: size as indicated, green jacketed, copper, with thermoplastic insulation type TWH rated at 600 V, minimum FT1, typically used for insulated ground wires. Alternatively, RW90 XLPE with minimum FT1 is also acceptable.

2.3 Connectors and Fasteners

.1 Dry Locations Only (above grade, or inspection wells):

.1 Cast, set screw, or bolted are permitted.

.2 Cadweld joints are permitted.

.3 Use mechanical connectors for grounding connections to equipment provided with lugs.

.2 Compression-tool applied. Burndy “Hyground Compression System,” or equal.

.3 Grounding lugs where furnished as standard manufacturer’s items on equipment.

.4 Provide ground clamps which are CSA listed for use on copper or brass pipes.

.5 Provide ground clamps, for use on iron pipes, of galvanized or malleable iron, or of standard noncorrosive material for use on iron pipes.

.6 Provide ground clamps, for use on pipes, with rigid metal base providing good contact by proper seating on the pipe. Do not use strap type clamps.

2.4 Ground Rod Electrode

.1 Vertical Rod electrodes: copper clad steel, shall be a minimum size of 19 mm (3/4”) diameter by 3 m (10 ft) long.

.1 Where ground wells are indicated, provide a 12 inch deep, 8inch diameter precast concrete well with flush lid for accessibility and inspection of compressed connections.

.2 Ground rods shall be clean and smooth with the following characteristics:

.1 Cone-shaped point on the first section.

.2 Die-stamped near the top with the name or trademark of the manufacturer and the length of the rod in millimeters or feet.

.3 Install rod electrodes and make grounding connections.

2.5 Ground Plate Electrode

.1 Minimum copper surface area 2 m^2, 2 mm thick.

.2 Plate electrodes shall only be used in areas where bedrock prevents the use of vertical Rod electrodes. Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

.3 Install plate electrodes and make grounding connections.

2.6 Concrete Encased Electrode

.1 Copper conductor: minimum 6.0 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.

.2 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

.3 Install concrete encased electrodes with terminal connected to grounding network.

2.7 Ground Busbar Assemblies

.1 Facility Ground Busbar (for exposed wall-mount installations only):

.1 Provide tinned copper ground bar(s) complete with lugs suitable to terminate all ground cables, insulated supports, fastenings, connectors. Bus shall be complete with pre-drilled holes suitable for lug mounting as required. Refer to Drawings for further details.

.2 Installation shall be in accordance with CEC 10-616, and Table 16.

.3 Minimum cross-sectional area of the busbar shall be provided in accordance with Table 16, and the number of bonding connections required plus 20%. In smaller installations the minimum size shall be 12 mm thick, 100 mm high, and 1000 mm long.

.4 The minimum electrical rating for the ground bus shall be 600 V, factory complete with pre-installed 1.5 kV insulated stand-offs. Where installations call for back-to-back insulated stand-offs the ground bus shall first be ordered as a complete assembly that includes factory pre-installed insulated stand-offs to ensure the assembly arrives to site CSA certified/listed. Only onsite shall additional back-to-back insulated stand-offs be installed in addition to the standoffs that already come with the CSA certified/listed busbar assembly.

.5 The facility ground busbar assembly shall be ordered as a complete unit including insulated standoffs to maintain its certified/listing to C22.2 No. 27 (joint standard with UL 857 and NMX-J-148-ANCE). This standard applies to service-entrance, feeder, and branch-circuit busways and associated fittings rated at 600V or less, 6000A or less, and intended for use in accordance with the CEC (and NEC), NFPA 70, and the Mexican standard for Electrical Installations (Utility, NOM-001-SEDE). These requirements do not apply to metal enclosed bus intended for connecting switchgear assemblies for use in prefabricated electrical distribution systems.

.2 Cables shall be connected to ground bars via heavy duty, 2 Hole, compression Lug Connector for bolt-on connection to the ground busbar.

.1 Connectors for cables equal or less then 2/0 shall be compact type.

.2 Connectors for cables equal or greater then 3/0 shall be brazed type.

.3 Exterior/Outdoor Ground Busbar:

.1 The same requirements as the Facility ground Busbar above except:

.1 Bus bar shall have a minimum 18 pre-drilled holes, two standoff insulators, two stainless steel mounting brackets and four stainless steel assembly bolts and lock washer.

.2 The ground busbar assembly shall be installed an enclosure with a minimum rating of CSA/NEMA 3R.

2.8 Accessories

.1 Shall be non-corroding type, 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 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

2.9 Manufacturers

.1 Ground Rods (Copper):

.1 Thomas & Betts (ABB).

.2 Compression Connecting Hardware:

.1 Thomas & Betts (ABB).

.2 Brundy.

.3 Ground bar (tin plated) with Insulated Standoffs:

.1 Erico.

3. EXECUTION

3.1 Installation – General

.1 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

.2 Install complete permanent, continuous grounding system, including conductors, accessories. All connectors shall be installed in accordance with Manufacturers' requirements, and to the requirements of the local Authority Having Jurisdiction (AHJ). All frames and metallic enclosures of all electrical equipment and electrically operated equipment shall be grounded via a ground conductor.

.3 All bolted connections must be accessible.

.4 Bond individual cable tray sections with bonding jumpers.

.5 Ground all utility services to the electrical system ground.

.6 Bond all building columns, structural steel, and metal siding, within or forming part of building/facility envelope. Including any current carrying exposed metal such as fences, tanks, equipment, or structures using copper welding by thermit process.

.7 Expansion joints and telescoping sections of raceways shall be bonded using jumper cables as per Canadian Electrical Code.

.8 Protect exposed grounding conductors from mechanical injury.

.9 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.11 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.

.12 Ground secondary service pedestals.

.13 Protect exposed grounding conductors during and after construction.

3.2 Compression Fittings

.1 Use compression connectors for all grounding splices and terminations unless otherwise shown on the Drawings.

.2 Compression fittings will make a connection without corroding or loosening.

.3 The compression joint shall join all strands and not cause the parts to be damaged or weakened.

.4 Completed connection or joint shall be equal or larger in size than the conductors joined and have the same current-carrying capacity as the largest conductor.

.5 Paint buried ground connection with a bitumastic paint.

3.3 Installation of Grounding Conductors

.1 Install grounding conductors so that they will not be exposed to physical damage. Install connections firm and tight. Arrange conductors and connectors so no strain on connections.

.2 Run grounding conductors associated with direct burial cables in common trenches above cables except as indicated otherwise.

.3 Bury equipment grounding conductors 30 inches deep. Bring loops or taps up for connection to equipment or other items to be grounded.

.4 Where raceways are used to contain and protect grounding conductors, install in accordance with Division 26.

.5 Where bare grounding conductors are contained within metallic raceways, bond ends of raceways to conductors.

.6 Install loop type, low impedance, grounding system interconnecting all components so at least two grounding connections are provided for each major item of electrical equipment. Ensure that severing of any single grounding conductor in this system does not remove grounding protection on any major item.

.7 Connect structural steel to the external perimeter loop of grounding conductors installed around all sides of building foundation as indicated on the Drawings otherwise buried a minimum 30 inches below grade. Connect to each vertical column by loop or tap. Connect two opposite points on external loop to two different points on grounding system.

.1 Connect building structural steel and metal siding to ground by welding copper to steel.

.8 Make accessible connections to structural members by bolted connector. Connections to equipment or ground bus by bolted connectors.

3.4 Installation of Ground Rods

.1 Install ground rods in manholes in accordance with requirements specified under the section Underground Distribution Systems. Connect each grounding conductor entering a manhole to ground rod by compression joint.

.1 Install conveniently located grounding electrode and size 3/0 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.

.2 Install ground rods where indicated. Unless otherwise indicated on the Drawings, install the top of the rod 12 inch (300 mm) below the ground surface.

.3 Make connection to overall grounding system as indicated.

.4 Connect individual ground rods to the grounding loop using the direct burial grounding cable.

.5 Make grounding connections in radial configuration only, with connections terminating at single grounding point with CT’s of equal spacing. Avoid loop connections.

3.5 Equipment Grounding

.1 Connect grounding conductors from equipment in area where ground bus is required to ground bus. Connect ground bus to grounding system.

.2 All frames and metallic enclosures of all electrical equipment and electrically operated equipment shall be grounded via a ground wire. Use mechanical connectors for grounding connections to equipment provided with lugs.

.3 Facility Distribution Equipment:

.1 All service equipment, power transformers, switchgear, motor control centers (MCCs), switchboard/panelboards and splitters fed from the main distribution centre shall be grounded by grounding conductors sized as shown, or as required by code. The ground conductor shall be terminated at each end with an appropriate grounding lug which shall be connected to the equipment ground bus. Provide grounding conductor with green insulation. Use mechanical connectors for grounding connections to equipment provided with lugs.

.1 Install electrical room ground bus to wall at location as indicated, utilizing insulated off sets.

.2 All main distribution centres, MCCs, switchgear, and all panels requiring equipment grounds shall contain a ground bus of adequate size, and tapped for lugs for the ground conductor required.

.3 Connect two (2) separate ground connections from ground grid to ground bus of switchgear assemblies, MCCs, switchboards and all outdoor substation and transformer equipment. Ensure that each connection for item of equipment is from different section of ground grid.

.4 Connect a grounding conductor between panelboard and grounding system. Where a grounding bar is furnished with panelboard, connect grounding conductor to bar.

.5 Connect power transformer cases and neutrals to grounding system. Connect neutral ground connection at transformer terminal. Provide two (2) separate, independent, diagonally opposite, connections for power transformers so removal of one connection will not impair continuity of other.

.1 Connect generator neutral to grounding system by a grounding conductor. Connect grounding conductor to generator disconnect enclosure and generator neutral on generator side of disconnect. Ground generator frame with two separate independent connections, so removal of one connection will not impair continuity of other.

.2 All sub panels such as lighting panels, local distribution panelboards, etc., shall be grounded with a green ground conductor run back to the panel from which it is fed. The ground conductor shall be sized according to the Canadian Electrical Code.

.3 Install grounding connections to duct systems, frames of motors, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

.4 Connect surge protection devices to ground system by suitable conductors. Where lightning arresters are furnished with electrical equipment and grounding connections are not inherently provided, ensure that suitable separate grounding conductor connects lightning arresters with system ground.

.5 Other Equipment:

.1 Ground each piece of electrical equipment by means of a grounding & bonding conductor installed in raceway feeding that piece of equipment. Grounding conductors installed in conduit with insulated conductors to be furnished with green, 600 volt insulation. Ground conductors are in addition to and not to be considered as the neutral wire of the system, and may be additional bonds as indicated on the Drawings.

.2 All motors shall be bonded by means of an adequately sized ground conductor contained within the feeder cable. In larger sized motors installations, or as indicated on the Drawings, or where specialty applications require it provide an additional bonding conductor.

.1 Install a separate grounding conductor from ground system to motors of 100 horsepower and larger, in addition to the raceway system. Ground motor ground connection to motor frame, independent of mounting bolts or sliding base. Ground motor to nearest point on grounding system, unless otherwise indicated.

3.6 Conduits

.1 Include a separate green ground conductor in all power conduits including branch circuit wiring sized to Canadian Electrical Code.

.2 Install RPVC conduit sleeves where ground conduits pass through concrete slabs.

.3 Conduit installed buried in earth or installed in or under grade floor slabs shall have separate ground conductors installed.

.4 Conduits entering metal enclosures shall utilize bonding type locknuts and grounding bushings. Locknuts that gouge into the metal enclosures are not acceptable.

.5 Where conduits are not effectively grounded by firm contact with a grounded enclosure, apply grounding bushings on at least one end of conduit run. Conduit connections shall be wrench tight.

.6 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.

3.7 Other Outdoor Grounding

.1 Ground each street lighting standard by ground rod driven near base of standard, in accordance with requirements of CSA. Connect ground rods to grounding conductor brought with street lighting feeder cable.

.1 Ground transformers, lightning arresters, insulators and other appurtenances, installed on poles, poles and timber structures, or metal structure. Run grounding conductors between poles or structure and ground rods. Install ground rod at base of pole and drive the rod down until it is a minimum of 300 mm (12”) below ground.

.2 Wood poles: Provide protective molding cover over the grounding conductor to a height at least 2500 mm (8 feet) above ground, with both molding and conductor stapled.

.3 Install separate ground conductor to outdoor lighting standards.

.2 Ground wire fences when used to enclose electrical equipment or when overhead electrical lines cross fence. Unless otherwise indicated, provide grounding by buried outside peripheral ground loop; connections to each corner fence post and nearby ground rod; flexible connections to each gate; and at least two connections to grounding system from approximately opposite positions on fence.

3.8 Signal Grounding

.1 Ground signal surge protection and shields of twisted, shielded cable using a signal bonding conductor. The signal bonding conductor shall be a continuous path from the instrument surge protection or shield to the grounding electrode conductor. The signal bonding conductor shall be isolated from the equipment grounding conductor for its entire path.

.2 Where convenient several signal bonding conductors may be combined, providing that all the following conditions are met:

.1 The combined signal bonding conductor shall have the equivalent cross section of the conductors that it was combined from or three times the cross section of the largest conductor that it was combined from, whichever is less.

.2 The combined signal bonding conductor shall be isolated from the equipment grounding conductor.

.3 Where two signal bonding conductors are combined use a three port insulated splice.

.4 Where three or more signal bonding conductors are combined, use a copper bus mounted on 600 volt insulators. Attach each conductor to the bus using an insulated ring tongue lug and screw terminal.

3.9 Neutral Grounding

.1 Install system and circuit grounding connections to neutral of secondary 480 V and 600 V systems.

.2 Connect transformer neutral and distribution neutral together using 1000 V insulated conductor to one side of ground test link, the other side of the test link being connected directly to main station ground. Ensure distribution neutral and neutrals of potential transformers and service banks are bonded directly to transformer neutral and not to main station ground.

.3 Interconnect electrodes and neutrals at each grounding installation.

.4 Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.

.1 Run a second Neutral cable for transformers as indicated on the Drawings.

.5 Ground transformer tank at 2 diagonal points from the ground grid around the transformer and add four ground rods around the transformer pad. The neutral of the secondary winding of the transformer shall use 1000V insulated cables and connected to the ground grid.

3.10 Communications Grounding

.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.

.1 Install one No. 2 insulated ground conductor to ground bus in telephone equipment cabinet.

.2 Connect one No. 12 insulated ground conductor to all conduits terminating at backboard.

.2 Sound, fire alarm, intercommunication systems as indicated.

3.11 Field Quality Control

.1 Perform tests in accordance with Division 26.

.2 Test grounding systems for ground resistance. Total resistance from any point on the ground network to the building counterpoise must not exceed 50 milliohms.

.3 Ensure that final resistance of interconnected ground system is 5 ohms, or less.

.1 Ground resistance and counterpoise tests must be made during dry weather and no sooner than forty-eight (48) hours after rainfall. Conditions of soil and weather shall be documented on test forms.

.2 Complete grounding testing and validations prior to backfill.

.4 Perform continuity test on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

.5 Indicating instrument must be self-contained and include a direct-current generator, synchronized current and potential reversers, crossed-current and potential coils, direct-reading ohmmeter, series resistors, and range-selector switch. Calibrate direct-reading ohmmeter for ranges of 0 to 20 ohms and 0 to 200 ohms.

.6 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.

.1 Temporary disconnect the two grounding conductors between the facility ground busbar and the facilities underground grounding system. Reconnect when testing is complete.

.2 Mark on the Drawings clarifying ground rod(s) where the testing took place (i.e. Gridline X and Gridline X).

.3 Optional Method 1 – The 4-pole Earth Resistance Test:

.1 On the markup drawing, include the Testing instrument electrode names and distance between them.

.2 Place auxiliary grounding electrodes in accordance with instrument manufacturer's recommendations but not less than 50 feet (15 m) apart, in accordance with IEEE Standard 81.

.4 Optional Method 2 – The Induced Frequency Method (Radio method):

.1 If proceeding with this method ensure a minimum of 4 ground rods are checked (i.e. at each corner of the grid or facility).

.2 Measures the ratio of the resistance to earth of an auxiliary test electrode to the series resistance of the electrode under test and a second auxiliary electrode. Perform measurements in accordance with IEEE Standard 81.

.7 Perform tests before energizing electrical system.

.8 Disconnect ground fault indicator during tests.

.9 Submit all ground continuity and resistance test results and markup sheets within three (3) days of field tests, and prior to commissioning activities for Contract Administrator's review.

3.12 Contract Closeout

.1 Provide in accordance with Division 1.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Supply and install all hangers, supporters and inserts for the installation shown on the Drawings and specified herein, as necessary to fasten electrical equipment securely to the building structure.

.2 Provide supports from building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.2 References

.1 ASTM International (ASTM):

.1 A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.3 A924/A924M, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

.4 E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.5 E119, Standard Method for Fire Tests of Building Construction and Materials.

.6 E814, Standard Test Method of Fire Tests of Through Penetration Firestops.

.2 FM Global (FM):

.1 Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

.3 Canada Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.4 Manitoba Electrical Code (MEC):

.1 Manitoba amendments to the Canadian Electrical Code.

.5 Underwriters Laboratories, (UL): Applicable listings.

.1 FRD, Fire Resistance Directory.

.2 263, Fire Tests of Building Construction and Materials.

.3 723, Test for Surface Burning Characteristics of Building Materials.

.4 1479, Fire Tests of Through-Penetration Firestops.

1.3 Submittals

.1 Submit the Shop Drawings in accordance with Division 1 and Division 26.

.2 Submit Shop Drawings and manufacturers' product data in accordance with the requirements of Section 26.

2. PRODUCT

2.1 Framing and Support System

.1 Materials:

.1 Intermediate duty supporting structures shall employ 41 mm square strut channel together with the Manufacturer’s connecting components and fasteners for a complete system.

.2 Heavy duty supporting structures to be fabricated and welded from steel structural members and prime painted before installation.

.3 Shall be rated for use in hazardous locations and category environments as necessary.

.4 Steel or malleable iron.

.5 Aluminum where indicated.

.6 Stainless steel where indicated.

.2 Coatings/Finishes:

.1 Provide products for use outdoors.

.1 Hot dipped galvanized.

.2 Supports, support hardware, fasteners, nuts, bolts, machine screws:

.1 Protect Steel and malleable iron:

.1 Cadmium plated for assemblies where sacrificial deterioration would normally take place damaging other fittings.

.2 Zinc coated where sacrificial deterioration will not take place.

.3 Use PVC coating where indicated on Drawings.

.3 Square strut channel:

.1 Section 41 mm square strut channel or as required for load and span, with mounting screws, or approved. 41 mm square strut channel is a minimum standard for supporting conduits 50 mm and larger.

2.2 Concrete and Masonry Anchors

.1 Materials: hardened steel inserts, zinc plated for corrosion resistance. All anchor bolts must be galvanized.

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four (4).

2.3 Non-Metallic Anchors

.1 Material: plastic anchors for sheet metal screws.

2.4 Cable Supports and Clamps

.1 General: as per conduit supports, except that for single conductor cables, suitable non-ferrous, or approved stainless steel or aluminum clamps shall be used.

2.5 Manufactured Supporting Devices

.1 Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

.2 Fasteners: Types, materials, and construction features as follows:

.1 Expansion Anchors: Carbon steel wedge or sleeve type.

.2 Toggle Bolts: All steel springhead type.

.3 Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for intended service.

.4 Nuts, Washers, and Bolts: Stainless steel.

.3 Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

.4 Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers.

.5 U-Channel Systems: Channels, with 9/16 inch (14 mm) diameter holes, at minimum of 8 inch (200 mm) on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of same manufacture.

2.6 U-Channel Systems

.1 Manufacturers, Stainless Steel/Galvanized Steel Channel.

.1 Unistrut Corp.

.2 B-Line Systems, Inc.

.2 Provide Type 316 stainless steel channel with corresponding accessories.

.3 Channels, with 9/16 inch (14 mm) diameter holes, at minimum of 8 inch (200 mm) on center, in top surface.

.4 Provide fittings and accessories that mate and match with U-channel and are of same manufacture.

.5 Provide hot-dipped galvanized after fabrication for steel channel and accessories.

.6 Provide channel of the proper material to match equipment classifications.

2.7 Fabricated Supporting Devices

.1 Shop or field fabricate supports or manufacture supports assembled from U-channel components.

.2 Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

.3 Pipe Sleeves: Provide pipe sleeves using one of the following:

.1 Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from following gage metal for sleeve diameter noted:

.1 3 inch (75 mm) and smaller: 20 gage (0.9 mm).

.2 4 inch (100 mm) to 6 inch (150 mm): 16 gage (1.5 mm).

.3 Over 6 inch (150 mm): 14 gage (1.9 mm).

.2 Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

.3 Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

2.8 Fire Resistant Joint Sealers

.1 Manufacturers:

.1 “Dow Corning Fire Stop Foam,” Dow Corning Corp.

.2 “Pensil 851,” General Electric Co.

.3 Or Approved Equal.

.2 Two part, foamed-in-place, silicone sealant formulated for use in through penetration fire stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.

.3 Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E814, by Underwriters’ Laboratories, Inc., or other testing and inspection agency acceptable to Authorities Having Jurisdiction.

3. EXECUTION

3.1 General

.1 Do not cut or drill beams, joists or structural steel unless written permission of the Contract Administrator is obtained.

.2 Distance between conduit or cable supports not to exceed code requirements.

.3 Supports to be suitable for the real loads imposed by equipment.

.4 Supports to be securely fastened, free from vibration and excessive deflection or rotation. Maximum deflections are 4 mm over a 1 m span and 8 mm over a 2 m span.

.5 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.6 Provide rack with 25% spare capacity for multiple runs.

.7 Provide channel support with fittings for vertical runs of conduit and cables.

3.2 Installation

.1 Coordinate with structural system and with other electrical installations, the building manufacturer, or structural engineer. Ceiling installations shall only commence after confirming the anticipated weight and attachment locations have been coordinated with the building manufacturer, or structural engineer.

.2 Install supporting devices to fasten electrical components securely and permanently in accordance with CSA and Building code requirements.

.1 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.3 Secure equipment:

.1 To solid masonry, tile and plaster surfaces with lead anchors or nylon shields.

.2 To poured concrete with expandable inserts.

.3 To hollow masonry walls or suspended ceilings with toggle bolts.

.4 For surface mount with twist clip fasteners to inverted T-bar ceilings. Ensure that T-bars are adequately supported to carry weight of equipment specified before installation.

.4 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole malleable iron or steel straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel Work.

.5 Suspended support systems:

.1 Support individual cable or conduit runs with a minimum of 6 mm diameter threaded rods and spring clips.

.2 Support two (2) or more cables or conduits on channels supported by a minimum of 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.3 When selecting threaded rod utilize a safety factor of five (5) times the maximum load tray system load (i.e. the installed weight needs to be less than the maximum load divided by 5). Loading factors may vary by manufacturer, threading type and pitch, material properties, anchoring, accessories, mechanical/seismic moments, stiffners etc. Also refer to the manufacturers product literature for additional requirements and limitations.

.1 All other materials for the cable tray support system(s) shall be a minimum of three (3) times the weight of all cabling installed in the cable tray / channel.

Threaded Rod Size mm (inches)	**Maximum Load kN (lbs)**
6 (1/4)	1.07 (240)
8 (5/16)	1.78 (400)
10 (3/8)	3.24 (730)
13 (1/2)	6.00 (1350)
16 (5/8)	9.60 (2160)
19 (3/4)	14.37 (3230)
22 (7/8)	19.93 (4480)
25 (1)	26.24 (5900)

.6 The Contractor shall NOT:

.1 Use plastic anchors unless for lighter loads. Use metal anchors for all other loads.

.2 Use wire lashing or perforated strap to support or secure raceways or cables.

.3 Use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Contract Administrator.

.4 Use Shot driven pins. These may only be used with written approval of the Contract Administrator.

.7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.9 Raceway Supports: Minimum material requirements:

.1 Conform to manufacturer’s recommendations for selection and installation of supports.

.2 Strength of each support shall be adequate to carry present and future load multiplied by safety factor of at least 4. Where this determination results in safety allowance of less than 200 lbs (890 N), provide additional strength until there is minimum of 200 lbs (890 N) safety allowance in strength of each support.

.3 Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

.4 Support parallel runs of horizontal raceways together on trapeze-type hangers.

.5 Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 inch (25 mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch (6 mm) diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

.6 In vertical runs, arrange support so load produced by weight of raceway and enclosed conductors is carried entirely by conduit supports with no weight load on raceway terminals.

.10 Vertical Conductor Supports: Install simultaneously with installation of conductors.

.11 Sleeves: Install in concrete slabs and walls and other fire-rated floors and walls for raceways and cable installations. For sleeves through fire rated wall or floor construction, apply CSA/cUL listed firestopping sealant in gaps between sleeves and enclosed conduits and cables. Refer to Building code, Division 7, and Division 26 for further requirements.

.12 Conduit Seals: Install seals for conduit penetrations of slabs below grade and exterior walls below grade and where indicated required by Code. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

.13 Conduit extending through roof shall pass through ceiling box at roof line.

.1 Provide 14 gage (1.9 mm) minimum copper box complete with watertight soldered seams and flanged to serve as pitch pocket for each conduit.

.2 Install conduit and pitch pocket in advance of roofing work.

.14 Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with following:

.1 Fasten by means of wood screws or screw type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring tension clamps on steel. Threaded studs driven by powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

.2 Holes cut in concrete shall not cut main reinforcing bars. Fill holes that are not used.

.3 Load applied to any fastener shall not exceed 25% of proof test load. Use vibration and shock resistant fasteners for attachments to concrete slabs.

.15 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four (4) 6 mm fasteners.

.1 Use round or pan head screws for fastening straps, boxes, etc.

3.3 Channels

.1 Support electrical components as required to produce same structural safety factors as specified for raceway supports.

.2 Install metal U-channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

.3 Install Type 316 stainless steel for mounting of electrical equipment in outdoor areas and on below grade, outside building and structure walls.

.4 Install galvanized steel channels for interior building mounting of electrical equipment except for those locations listed above and unless otherwise indicated.

.5 Concrete walls and ceilings: Surface mount set in poured concrete with a minimum size of 41 x 41 mm, 2.5 mm thick of U-shape type.

3.4 Contract Closeout

.1 Provide in accordance with Division 1.

END OF SECTION

1. GENERAL

1.1 Section Includes

.1 Materials and components for splitters, junction, pull boxes and cabinets.

1.2 References

.1 Canadian Standards Association (CSA International):

.1 CSA C22.2 No. 0, General requirements – Canadian Electrical Code, Part II.

.2 CSA C22.2 No. 0.4, Bonding of electrical equipment.

.3 CSA C22.2 No. 14, Industrial control equipment.

.4 CSA C22.2 No.76, Splitters.

.5 CSA C22.2 No. 30, Explosion-proof equipment.

.6 CSA C22.2 No. 40, Junction and pull boxes.

.7 CSA C22.2 No. 94, Special Purpose Enclosures.

.8 CSA C22.2 No. 94.1, Enclosures for electrical equipment, non-environmental considerations (Tri-national standard with NMX-J-235/1-ANCE and UL-50).

.9 CSA C22.2 No. 94.2, Enclosures for electrical equipment, environmental considerations (Tri-national standard with NMX-J-235/2-ANCE and UL-50E).

.10 CSA C22.2 No. 286, Industrial control panels and assemblies.

.2 Electrical Equipment Manufacturers Association of Canada (EEMAC), now known as Electro-Federation Canada.

.3 Manitoba Building Code (MBC):

.1 The Buildings and Mobile Home Act amendments to the National Building Code of Canada (NBC).

.4 Manitoba Electrical Code (MEC):

.1 Manitoba amendments to the Canadian Electrical Code (CEC).

.5 National Electrical Manufacturers Association (NEMA):

.1 NEMA ICS 6, Industrial Control and Systems: Enclosures.

.6 Winnipeg Electrical By-law (WEB):

.1 Winnipeg amendments to the Canadian Electrical Code (CEC).

.7 Winnipeg Building By-law (WBB):

.1 Winnipeg amendments to the National Building Code of Canada (NBC).

.8 Underwriters Laboratories Canada (cUL):

.1 508A, Industrial Control Panels.

.2 698A, Industrial Control Panels Relating to Hazardous (Classified) Locations.

.3 1203, Explosion Proof and Dust-Ignition Proof Electrical Equipment for Use in Hazardous (Classified) Locations.

1.3 Shop Drawings and Product Data

.1 Submit Shop Drawings and product data indicating the components and equipment/cabinets in accordance with Division 1 and Division 26.

.1 Manufacturer's data sheets for each type of junction box, cabinet, splitter, and pull box.

.2 Provide Manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size/dimensions, enclosure ratings, lug/terminal ratings, accessories/components, finish and limitations.

.1 Provide clarification in which area each type of enclosure / box will be installed, and its intended application.

.3 All materials shall be CSA certified or cUL listed and selected for the application and the environment for which it is installed in. When codes or standards require the enclosure to be certified it shall be manufactured and certified by a local panel shop. Refer to the Drawings and Division 26 for additional information on the intended CSA/NEMA/EEMAC ratings of enclosures by area.

2. PRODUCTS

2.1 Environmental Considerations

.1 Intended to be installed in dry, non-hazardous, non-corrosive process locations:

.1 To be constructed of painted, mild steel.

.2 Back-plate with offsets for installation of devices.

.3 Continuous piano hinge, gasketed seal on door with quarter turn latch and handle.

.2 Intended to be installed in wet or corrosive locations:

.1 Constructed of cast aluminum with threaded connection.

.2 Termination of underground PVC conduit system may be made into an exterior mounted, rigid PVC or Fiberglass enclosure type 4X as applicable.

.3 Utilize 316 stainless steel bolts, washers and mounting hardware.

.3 Intended to be installed in hazardous locations:

.1 Constructed of cast copper free aluminum with threaded connection.

.2 Hinged, bolt-on style aluminum cover with neoprene gasket.

.3 Factory installed aluminum mounting plate for terminals, lugs and electrical devices.

.4 Factory installed threaded openings for conduit and cable connections.

.5 Utilize 316 stainless steel bolts, washers and mounting hardware.

2.2 Junction Boxes, and Pull Boxes

.1 Materials:

.1 Code gauge sheet steel, welded construction, phosphatized and factory paint finish.

.2 Components:

.1 For flush mounting, covers to overlap box by 25 mm minimum all around with flush head cover retaining screws.

.2 Use rolled edges for surface boxes.

2.3 Splitters

.1 General:

.1 Three (3) sets of lugs for phases plus neutral, minimum, sized and suitable for conductor termination.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 Provide ground bar, with a minimum of three (3) terminals.

.2 Splitters shall include a hinged lockable cover.

.3 Do not install splitters in hazardous or corrosive areas. If required, install suitable, Class I junction boxes.

2.4 Cabinets

.1 Materials:

.1 Locks: to match panelboards.

.2 Components:

.1 With hinged door and return flange overlapping sides, with handle, lock and catch for surface mounting, size as indicated or to suit.

.2 Install a back mounting plate for DIN rail mounted terminal blocks. Plate to be painted white enamel.

.3 Install metal divider in cabinets with more than one voltage.

.4 Surface or flush with trim and hinged door, latch and lock and two (2) keys, size as indicated or to suit. Keyed to match panelboard keys 19 mm.

3. EXECUTION

3.1 Installation

.1 Boxes mounted in exterior walls shall be complete with box vapour barriers and gasketing/flashing/sealing per Manitoba Building Code. Maintain wall insulation.

.2 Install in inconspicuous but accessible locations, with a minimum 1m of clearance in front of the equipment in accordance to CEC for working space, and to egress requirements per Building Code.

.1 If junction boxes are required in inaccessible location, provide a suitable access panel which allows sufficient space for opening the junction box.

.3 Junction Boxes and Pull Boxes:

.1 Supply all pull boxes and junction boxes shown on the Drawings or required for the installation.

.2 Boxes installed in party walls to be offset by a minimum of one stud space.

.3 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.

.4 Identify with system name and circuit designation as applicable.

.5 Size in accordance with the Canadian Electrical Code, as a minimum.

.6 Terminate cables and conductors as required.

.1 For control signals install terminal block, Weidmuller WDU4 or equivalent.

.7 Make all necessary cable entry holes in junction boxes supplied by Contractor or others, regardless of material.

.4 Splitters:

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

.5 Cabinets:

.1 Mount cabinets with top not greater than 1980 mm above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items.

.2 Install terminal block, Weidmuller WDU4 or equivalent.

.6 Unapproved Electrical Equipment:

.1 The Manitoba Electrical Code (MEC) allows the use of an unapproved Control Box provided all the requirements as outlined under MEC 2-204-4 are followed and provided.

.1 Clarification: Within the jurisdiction of Winnipeg the WEB 2-024 does not allow use of unapproved electrical equipment. Therefore the use any unapproved electrical equipment will be rejected and will require either complete replacement, or the contractor will provide CSA Special inspection certification and remediation of the same at no additional cost to the Contract.

3.2 Identification

.1 Provide equipment identification in accordance with Division 26.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Provide a complete installation which includes various boxes and materials for the miscellaneous wiring and equipment as required throughout the Contract Documents.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 CSA C22.2 No. 14, Industrial control equipment.

.3 CSA C22.2 No. 18.1, Metallic outlet boxes (Tri-national standard with ANCE NMX-J-023/1 and UL514A).

.4 CSA C22.2 No. 18.2, Nonmetallic outlet boxes.

.5 CSA C22.2 No. 18.3, Conduit, tubing, and cable fittings (Tri-national standard with ANCE NMX-J-017 and UL514B).

.6 CSA C22.2 No. 18.4, Hardware for support of conduit, tubing, and cable (Bi-national standard with UL-2239).

.7 CSA C22.2 No. 18.5, Positioning devices (Bi-national standard with UL-1565).

.8 CSA C22.2 No. 25, Enclosures for use in Class II, Division 1, Groups E, F, and G hazardous locations.

.9 CSA C22.2 No. 30, Explosion-proof equipment.

.10 CSA C22.2 No. 213, Non-incendive electrical equipment for use in Class I and II, Division 2 and Class III, Division 1 and 2 hazardous (classified) locations (Bi-national standard with ISA 12.12.01).

.2 Winnipeg Electrical By-law (WEB):

.1 Winnipeg amendments to the Canadian Electrical Code (CEC).

.3 Winnipeg Building By-law (WBB):

.1 Winnipeg amendments to the National Building Code of Canada (NBC).

.4 Underwriters Laboratories Canada (cUL):

.1 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

.2 1203, Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.

1.3 Shop Drawings and Product Data

.1 Submit product data in accordance with Division 1 and Division 26.

2. PRODUCTS

2.1 Boxes/Bodies General

.1 Size boxes as required to accommodate wiring devices, and in accordance with the CEC.

.2 Boxes shall be environmentally rated and suitable for the installation location. Refer to the drawings and Division 26 for area classifications and additional requirements.

.3 A minimum 100 mm (4”) square or larger outlet boxes as required for special devices.

.4 Gang boxes where wiring devices are grouped.

.5 Blank cover plates for boxes without wiring devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

.7 Knock-out covers for sealing penetration holes.

2.2 Sheet Metal Boxes – Dry Unclassified Area

.1 Hot dipped galvanized steel.

.2 All 100 mm (4”) square boxes shall be minimum 40 mm deep.

.3 Deep boxes shall be installed where required.

.4 Device boxes shall be minimum 64 mm deep.

2.3 Boxes for Rigid Metal Conduit – Non-Explosionproof

.1 Materials:

.1 Surface mounting exposed: cast copper-free aluminum, ferrous for threaded rigid conduit, with attached mounting lugs, with factory-threaded hubs and plugs, two coats corrosion resistant finish, wet location rated, gasketed covers.

.2 Ceiling outlets (surface mounting):

.1 Manufacturer/Model: Eaton (Crouse-Hinds) VXF/VFT series, or approved equal.

.3 Wall outlets, Wall switches, and Device Boxes (surface mounting):

.1 For exposed mounting either indoors or outdoors.

.2 Single gang, 2-gang, 3-gang as required.

.3 Manufacturer/Model: For one or more gang, Eaton (Crouse-Hinds) FS series or FD series, or approved equal.

.4 Covers: unless wiring devices and plates are mounted, provide blank, round canopy covers to match boxes.

.4 Conduit Junction Boxes (surface mount):

.1 Minimum size of 100 mm (4") round.

.2 Manufacturer / Model: Eaton (Crouse Hinds) GRF or VXF series, or approved equal.

.5 Condulet Outlet Bodies:

.1 For wiring pull points.

.2 Manufacturer / Model: Eaton (Crouse Hinds) Form 7 series, (C, E, L, LB, LL, LR, T, TA, TB, X) to suit the application, or approved equal. All blank covers to be cast aluminum, gasketed wedgenut style covers.

2.4 Boxes for Rigid Metal Conduit – Explosion Proof

.1 Materials:

.1 Surface mounting exposed: cast copper-free aluminum, ferrous for threaded rigid conduit, with attached mounting lugs, with factory-threaded hubs and plugs, two coats corrosion resistant finish, wet location rated, gasketed covers.

.2 Rated for the Hazardous Location.

.2 Conduit Junction Boxes (surface mount):

.1 Minimum size of 100 mm (4") round.

.2 Manufacturer / Model: Eaton (Crouse Hinds) GUA, GUR, EAB, EAJ series, or approved equal.

.3 Condulet Outlet Bodies:

.1 For wiring pull points.

.2 Manufacturer / Model: Eaton (Crouse Hinds) OE series, LBH series, LBY series to suit the application, or approved equal.

.4 Wall outlets, Wall switches, and Device Boxes (surface mounting):

.1 Single gang, 2-gang, 3-gang as required.

.2 For exposed mounting either indoors or outdoors.

.3 Manufacturer / Model: Eaton (Crouse Hinds) EDS or EDSCM series to suit the application, or approved equal.

2.5 Fittings - General

.1 Materials and type to suit the conduit type and the installation requirements.

.2 Bushing and connectors with nylon insulated throats.

.3 Knock-out fillers to prevent entry of debris.

.4 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.5 Double locknuts and insulated bushings on sheet metal boxes.

.6 Thread Lubricant:

.1 Use thread lubricant to prevent galling of conduit threads when threaded into a coupling, junction box etc. Maintains grounding continuity.

.2 Manufacturer / Model:

.1 Eaton (Crouse Hinds) HTL series.

.2 Emerson (Appleton) TLC series.

.3 Hubbell (Killark) LUBG/LUBT series.

2.6 Fittings for Rigid Metal Conduit – Explosion Proof

.1 Copper free aluminum, threaded fittings for explosion proof hazardous areas.

.2 Sealing fittings:

.1 Manufacturer / Model:

.1 Eaton (Crouse Hinds) EYS-SA, EZS-SA.

.2 Emerson (Appleton) type EYF-AL or EYM-AL.

.3 Hubbell (Killark) type EY or EYS.

.3 Drain sealing fittings:

.1 Manufacturer / Model:

.1 Eaton (Crouse-Hinds) type EYD-SA or EZD-SA.

.2 Emerson (Appleton) type EYDM-A.

.4 Drain / breathers:

.1 Manufacturer / Model:

.1 Eaton (Crouse Hinds) ECD series.

.2 Emerson (Appleton) type ECDB.

.5 Threaded unions:

.1 Manufacturer / Model: Crouse Hinds UNF/UNY series to suit the application, or approved equal.

.6 Sealing Compound:

.1 All sealing compounds and manufacturer specific requirements shall be followed, and shall match those listed under the CSA certificate or cUL listing.

.2 Manufacturer / Model:

.1 Eaton (Crouse Hinds) Chico sealing compound or Chico speed seal.

.2 Emerson (Appleton) Kwiko sealing compound and fiber filler.

.3 Hubbell (Killark) Killark sealing compound and fiber filler.

.7 Thread Lubricant:

.1 Use thread lubricant to prevent galling of conduit threads when threaded into a coupling, junction box etc. Maintains grounding continuity.

.2 Manufacturer / Model:

.1 Eaton (Crouse Hinds) HTL series.

.2 Emerson (Appleton) TLC series.

.3 Hubbell (Killark) LUBT series.

3. EXECUTION

3.1 Installation

.1 Adjust position of outlets in finished masonry walls to suit course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes.

.2 Outlets installed in partition walls to be offset by a minimum of one stud space.

.3 Confirm the direction of door swings on site, to confirm that outlet boxes for light switches are located on the latch side of the door.

.4 Provide boxes sized as required by the CEC.

.1 Extension rings shall not be utilized to accommodate conductor fill requirements.

.2 Do not use sectional boxes.

.5 Support boxes independently of connecting conduits.

.6 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of Work.

.7 Install all outlets flush and surface mounted as required for the installation.

.1 Surface mount above suspended ceilings, or in unfinished areas.

.2 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.3 Use plaster rings to correct depth. Use 30 mm on concrete block.

.8 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.

.9 Primary bushings in termination box for cable connection.

.10 Secondary bushings in termination box for bus duct connection.

.11 Control junction box.

.12 Exterior or wet, and/or corrosive areas:

.1 Boxes mounted in exterior walls shall be complete with box vapour barriers and gasketing/flashing/sealing per Manitoba Building Code. Maintain wall insulation.

.2 Install aluminum, threaded, gasketted, outlet boxes, conduit boxes, and fittings.

.13 Hazardous areas:

.1 Install aluminum, threaded, sealing fittings, conduit boxes, outlet boxes, unions, drains, expansion fittings, flexible couplings, and all other components approved for the hazardous area(s).

.2 Install fittings and seals in accordance with the Manufacturers requirements.

.3 The installation shall meet all requirements of the CEC, Section 18 and Section 22.

3.2 Identification

.1 Provide equipment identification in accordance with Division 26.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section provides a comprehensive list of all conduit types that may be required for the project and the applications where each type shall be used.

.2 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This section supplements requirements of other Divisions.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 CSA B137.1 Polyethylene (PE) Pipe, Tubing, and Fittings for Cold Water Pressure Services.

.3 CSA C22.2 No. 18.1 Metallic Outlet Boxes.

.4 CSA C22.2 No. 18.2 Non-metallic Outlet Boxes.

.5 CSA C22.2 No. 18.3 Conduit, Tubing, and Cable Fittings.

.6 CSA C22.2 No. 18.4 Hardware for the Support of Conduit, Tubing, and Cable.

.7 CSA C22.2 No. 18.5 Positioning Devices.

.8 CSA C22.2 No. 45.1 Electrical Rigid Metal Conduit – Steel.

.9 CSA C22.2 No. 45.2 Electrical Rigid Metal Conduit — Aluminum, Red Brass, and Stainless Steel.

.10 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.11 CSA C22.2 No. 83, Electrical Metallic Tubing (EMT).

.12 CSA C22.2 No. 211.1, Rigid types EB1 and DB2/ES2 PVC conduit.

.13 CSA C22.2 No. 211.2, Rigid PVC (unplasticized) conduit.

.14 CSA C22.2 No. 211.3, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings (Bi-National standard with UL-1684).

.15 CSA C22.2 No. 227.3, Mechanical Protection Tubing (MPT) and fittings (Tri-national standard with NMX-J-855-ANCE and UL-1696).

.16 CSA C22.2 No. 327, HDPE conduit, conductors-in-conduit, and fittings.

1.3 Submittals

.1 Submit product data in accordance with Division 1 and Division 26.

.1 Include certifications to appliable standards, ratings, and manufacturer specific installation requirements.

.2 Electric metallic tubing.

.3 Rigid aluminum conduit.

.4 Rigid PVC conduit.

.5 Flexible metal, liquid tight conduit.

.6 Flexible non-metallic, liquid tight conduit.

.7 Conduit fittings, conduit couplings.

.8 Hazardous area sealing fittings, coupling and sealing compound.

.9 Conduit clamps and support systems.

.10 Submit information on where each type of conduit will be installed, prior to installation.

.11 Submit details of the cUL approved fire stop assembly for approval prior to installation.

.2 The Drawings do not show every specific conduit run. Supply and install conduit, and support systems as required for a complete installation.

.3 The materials for each conduit must meet the requirements of the area. Some areas are wet, highly corrosive; other areas have chemicals which may adversely interact with specific materials. Care must be taken in making the proper conduit selection for the particular area.

.4 Design equipment anchorage and support system for vertical and lateral loading in accordance with the MBC.

.1 Submit written certification from a Professional Engineer licensed in the Province of Manitoba stating that support systems, anchorage, and equipment are structurally sound, and have been designed according to requirements of the MBC.

1.4 Coordination

.1 Coordinate with other work including wire and cable, boxes and fittings and panel work, as necessary to interface installation of conduit with other work.

.2 Coordinate installation of conduit in concrete with work specified in Division 3.

.1 Confirm size restrictions for concrete embedded conduit with structural engineer.

.3 Coordinate installation of conduit in masonry with work specified in Division 4.

.4 Coordinate installation of conduit which penetrates roof or waterproofing membranes with work specified in Division 7.

.1 Provide necessary flashing and pitchpockets, making watertight joints where conduit passes through roof or waterproofing membranes.

.5 Coordinate installation of conduit which penetrates fire rated walls, floors or ceilings with firestopping work specified in Division 1. Ensure that integrity of the fire rated element is maintained.

1.5 Quality Assurance

.1 Electrical equipment and materials shall be new and comply with the latest codes and standards. Unless otherwise called out in the Drawings, no used, re-built, refurbished and/or re-manufactured electrical equipment or materials shall be furnished on this project.

.2 Coated type conduits shall be prepared/repaired with cleaner, primer, and touch-up compound as per the manufacturers requirements.

.3 Installed conduit shall be free from dents, bruises and other damage.

1.6 Delivery, Storage and Handling

.1 Storage: Whenever possible, store the conduit indoors to prevent possible discoloration, the accumulation of dirt and to extend the life of the product. However, if conduit is stored outdoors, it should be stored in such a way as to allow air circulation and water to drain-off and shall not be directly covered in plastic.

2. PRODUCTS

2.1 Conduits and Minimum requirements

.1 Special attention to the selection of materials must take place in corrosive atmospheres where chemicals are stored, or chemical vapours may be present. Some processes utilize several different chemical types all with difference corrosive properties, if unsure of the material required for a chemical room or injection point request clarification from the Contract Administrator.

.2 Further application specific materials use have been provided throughout this document that cover a variety of rooms, areas, interior, exterior and a variety of installation types. If unsure of the material required for a specific area or installation request clarification from the Contract Administrator.

.3 Epoxy coated Conduit:

.1 Epoxy coated metal conduit is intended for hazardous areas above and below grade. The preferred metal is rigid threaded aluminum.

.2 CSA C22.2 No. 45.1, with zinc coated metal, with additional corrosion resistant epoxy finish inside and outside.

.3 CSA C22.2 No. 211.3 for rigid fibreglass reinforced epoxy conduit and associated fittings.

.4 PVC coated metal Conduit:

.1 PVC coated metal conduit is intended for hazardous areas above and below grade. The preferred metal is rigid threaded aluminum.

.2 CSA C22.2 No. 45.1, with zinc coated metal, with additional PVC coating.

.5 Rigid Aluminum, Red Brass, or Stainless Steel metal Conduit:

.1 For interior exposed applications, above grade. Rigid aluminum may be used in hazardous areas.

.2 CSA C22.2 No. 45.2, with factory applied, closed-end thread protectors.

.3 Rigid Aluminum shall meet a minimum alloy composition of Type AA6063.

.6 Flexible metal Conduit:

.1 Intended for connections to vibrating equipment, the flexible conduit is a short length with a connection between a permanent conduit system and the equipment. Also intended for connections to instruments where periodic inspection/adjustments/ calibrations may be required.

.2 CSA C22.2 No. 56, aluminum liquid-tight flexible metal.

.3 Flexible Metal Conduit: spirally wound, interlocked zinc coated strip steel, minimum 10 mm diameter.

.4 Liquid-Tight Flexible Metal Conduit: continuous interlocked and double-wrapped steel, zinc coated inside and outside, coated with liquid-tight jacket of flexible PVC, minimum 12 mm diameter.

.5 Liquid-Tight Flexible Metal Conduit Fittings: cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings.

.7 Flexible non-metal Conduit:

.1 Intended for connections to vibrating equipment, the flexible conduit is a short length with a connection between a permanent conduit system and the equipment. Also intended for connections to instruments where periodic inspection/adjustments/ calibrations may be required.

.2 CSA C22.2 No. 227.3, heavy duty, liquid tight, PVC.

.8 Galvanized-Steel Rigid Conduit:

.1 For exposed outdoor application above grade, or interior dry areas.

.2 CSA-C22.2 NO. 45.1 and ANSI C80.1, zinc coating steel.

.9 High Density Polyethylene (HDPE):

.1 Direct burial and horizontal directional drilling conduit applications. Used where specifically approved by the Contract Administrator.

.2 CSA C22.2 No. 327 testing requirements, for direct burial or encasement in concrete or masonry in ordinary (non-hazardous) locations.

.10 Rigid Polyvinyl Chloride (RPVC) Conduit:

.1 RPVC for interior exposed (wet or wet corrosive atmospheres) and outdoor direct burial applications. Used in above ground general location applications when embedded in concrete walls, ceilings, or floors.

.2 DB2 may be used for direct burial, and concrete encasement applications.

.3 CSA C22.2. No. 211.0 testing requirements.

.4 CSA C22.2 No. 211.1:

.1 Rigid Type EB1 PVC conduit: for encasement in masonry and concrete only.

.2 Rigid Type DB2/ES2 PVC Conduit: for direct burial and/or encasement in masonry and concrete.

.5 CSA C22.2 No. 211.2 for unplasticized conduit.

.1 Rated FT-4 for conduits trade sizes between ½" through to 6" when used in interior applications, and suitable for direct burial.

.11 Reinforced Thermosetting Resin Conduit (RTRC):

.1 For encased burial, or direct burial applications.

.2 CSA C22.2 No. 211.3

.12 Electrical Metallic Tubing (EMT):

.1 Used in lunch rooms and office spaces.

.2 EMT: to CSA C22.2 No.83.

.13 Mechanical Protection of direct burial conductors, as permitted under CEC 12-012(3)(e):

.1 Polyethylene Pipe: to CSA B137.1, minimum series 75.

.2 Flexible Plastic Underground Power Cable Ducting: to CSA C22.2 No. 211.1

2.2 Conduit Fastenings

.1 One hole stainless steel straps to secure surface conduits 50 mm and smaller.

.1 Two hole stainless steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1 m on centre.

.4 Strap material to match conduit material.

.5 Set screw fittings are not permitted.

.6 Threaded stainless steel rods, minimum 10 mm diameter, to support suspended channels.

2.3 Conduit Spacers

.1 PVC coated malleable metal spacers, CSA approved for the purpose.

.2 Aluminum channel may be utilized where conduits are grouped; however, a non-metallic spacer must be provided between the aluminum channel and concrete.

2.4 Conduit Fittings

.1 Fittings manufactured for use with conduit specified, CSA certified, and environmentally rated for the intended area of use.

.1 Miscellaneous Fittings: locknuts, bushings, reducers, chase nipples, 3 piece unions, split couplings, plugs, and expansion fittings specifically designed for their particular application.

.2 Coating: same as conduit.

.3 Hazardous Locations: All fittings, couplings and devices shall be rated for the Hazardous Classification(s).

.2 Utilize factory made elbows for 27mm and larger conduits.

.3 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

.4 Flexible Metal Conduit Fittings: threadless hinged clamp type.

.5 Electrical Metallic Tubing (EMT):

.1 Fitting Material for 25 mm size Conduit and Smaller: zinc alloy or zinc coated steel.

.2 Fitting Material for Conduit Larger than 25 mm Size: zinc coated steel.

.3 Type: compression or set screw, liquid tight for wet or damp areas.

.6 Flexible metal, liquid-tight conduit:

.1 Metal insulated throat connectors with integral nylon or plastic bushing rated for 105°C.

.2 Insulated throat and sealing O-rings.

.1 Manufacturers and Products – General Locations:

.1 ABB (Thomas & Betts); Series 5331.

.2 Manufacturers and Products – Hazardous Locations:

.1 Emerson (O-Z/Gedney); Series 4Q.

.7 Flexible, non-metallic, liquid-tight conduit:

.1 Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.

.2 Body/compression nut (gland) design to assure high mechanical pullout strength and watertight seal.

.3 Manufacturers and Products:

.1 Emerson (O-Z/Gedney); Type STN/LM/NM.

.2 ABB (Thomas & Betts); Series 6300

.3 Carlon; Type LT.

.8 PVC type:

.1 Meet requirements of NEMA TC-3.

.2 Type: PVC, slip-on.

2.5 Expansion Fittings for Rigid Conduit

.1 All conduits entering outlet boxes and devices that are located in walls subject to movement shall be terminated by means of liquid-tight flexible conduit, approximately 450 mm in length between the conduit and the outlet box or device which is being supplied. All conduits, bus duct, wireways, etc., passing through or across expansion joints of the building shall be installed with the use of approved expansion fittings.

.2 There are structural expansion joints in the facilities – these are not specifically identified on the electrical Drawings. Review the structural Drawings and note the locations of all expansion joints. Provide expansion couplings and fittings for all conduit crossing the joints. Do not locate rigid devices (for example panels) across or on top of the expansion joints. Add expansion fittings as required to accommodate expansion joints due to temperature variations.

.3 Expansion Fitting Manufacturers and Products:

.1 Deflection/Expansion Movement – General Locations:

.1 Emerson (Appleton) type DX.

.2 Eaton (Crouse-Hinds) type XD.

.2 Expansion Movement Only – General Locations:

.1 Emerson (Appleton) type XJ.

.2 Eaton (Crouse-Hinds) type XJ.

2.6 Fish Cord

.1 Polypropylene.

2.7 Conduit Bonding

.1 All conduits shall have a bare or insulated copper bonding conductor run within. The bonding conductor shall be sized as per the CEC, table 16. The conduit itself cannot be used as the only means of bonding. Provide bond jumpers between conduit systems, and to the bond terminals on pull boxes and junctions boxes to ensure electrical continuity of all conduit systems. Not all bond cables are shown on the Drawings or on the cables list. Provide bonds even though not explicitly indicated in other documentation.

.2 Utilize insulated grounding bushings / conduit hub at all enclosure entries for metallic conduit.

.1 Material: Cast aluminum, with integral insulated throat, rated for 150°C.

.2 Manufacturers and Products – General Locations:

.1 ABB (Thomas & Betts) Series 370AL.

.2 Emerson (O-Z/Gedney) Type AB.

.3 Emerson (O-Z/Gedney) Type ABLG

.3 Manufacturers and Products – Hazardous Locations:

.1 Emerson (O-Z/Gedney) Type HUBG.

.2 Eaton (Meyers; Crouse-Hinds) Series STGK/SSTGK.

3. EXECUTION

3.1 Routing

.1 Locate conduits containing communication and low voltage conductors away from conduits containing power wiring.

.2 Run parallel or perpendicular to building lines. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.

.3 Do not pass conduits through structural members except as specified on the Drawings, or as permitted by the Contract Administrator.

.4 Route conduits on suspended channels where possible.

.5 Avoid routes that would interfere with any potential maintenance activities.

.6 Where not specifically shown in detail on the Drawings, review proposed conduit routing with Contract Administrator prior to installation. Comply with all routing changes requested by the Contract Administrator.

.7 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

3.2 Spacing and Supports

.1 Wall spacing:

.1 Group conduits wherever possible on suspended or surface mounted channels.

.2 Install spacers as required to provide a space between the conduits and the supporting surface, with a minimum space as follows:

.1 Above grade spaces not classified as CEC Category 1 or 2:

.1 Drywall / wood surfaces: no space required.

.2 Masonry / concrete surfaces: 6 mm.

.3 Below grade spaces: 12 mm.

.2 Wet locations: 12 mm.

.2 Supports for metallic conduit:

.1 Maximum spacing between supports for metallic conduit:

.1 16 mm conduit: 1.0 m.

.2 21 mm conduit: 1.5 m.

.3 27 mm conduit 1.5 m.

.4 35 mm conduit 2.0 m.

.5 41 mm conduit and larger 2.5 m.

.3 Supports for PVC conduit:

.1 Maximum spacing between supports for rigid PVC conduit:

.1 21 mm conduit 0.75 m.

.2 27 mm conduit 0.75 m.

.3 35 mm conduit 0.75 m.

.4 41 mm conduit 1.2 m.

.5 53 mm conduit 1.5 m.

.6 63 mm conduit 1.5 m.

.7 78 mm conduit 1.5 m.

.8 91 mm conduit and larger 2.0 m.

3.3 Connections

.1 For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:

.1 Wet or corrosive areas: flexible, non-metallic liquid tight conduit.

.2 Dry and non-corrosive areas: flexible, metallic liquid tight conduit.

.3 Hazardous areas: flexible liquid tight conduit, with couplings and fittings suitable for Class I, Division 1 and 2 areas.

.4 Length: 450 mm minimum, 1500 mm maximum, sufficient to allow movement and adjustment of equipment.

.2 Luminaires in dry areas: flexible, metallic liquid-tight conduit or approved cabling.

.3 Transition from underground or concrete embedded to exposed: rigid PVC to rigid aluminum conduit.

.4 Exterior light pole foundations: rigid PVC conduit.

3.4 Bends

.1 Conduit runs shall not exceed four 90 degrees bends (for a total of 360 degrees) between pullboxes.

.2 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter. Bends are to be symmetrical.

.3 Avoid field-made bends and offsets, but where necessary, make with an acceptable bending machine. Do not heat metal raceways to facilitate bending.

.4 Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

.5 Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.

.6 Use factory made elbows for conduits over 27 mm in diameter.

.7 Install concealed raceways with a minimum of bends in the shortest practical distance.

.8 PVC Conduit:

.1 Bends 30 degrees and larger: provide factory made elbows.

.2 Use Manufacturer's recommended method for forming bends.

.9 Do not make bends that exceed allowable conductor or cable bending radius; or that significantly restrict cable pulls.

3.5 Penetrations

.1 Prior to coring, drilling or cutting through wall, roof or floor members: perform scan of the surface, mark the intended location, and confirm acceptability with the Contract Administrator.

.2 For circular penetrations, provided steel pipe (galvanized or stainless to suit the environment).

.3 Provide 88.9 mm high concrete curb around floor penetrations that are subject to regular clean up or wash down.

.4 Make at right angles, unless otherwise shown.

.5 Notching or penetration of structural members, including footings and beams, is not permitted unless specifically approved by the Contract Administrator.

.6 Firestop openings around penetrations to maintain fire-resistance rating.

.7 Apply single layer of wraparound duct band to all metallic conduit protruding through concrete floor slabs to a point 50 mm above and 50 mm below concrete surface.

.8 Concrete walls, floors, or ceilings (above ground): provide non-shrink grout dry-pack, or use watertight seal device.

.9 Entering Structures:

.1 General: seal raceway at the first box or outlet with oakum or expandable plastic compound to prevent the entrance of gases or liquids from one area to another.

.2 Exterior wall penetration:

.1 Utilize Roxtec weatherproof sealing system.

.2 Install to Manufacturer's recommendations.

.3 Install flush with exterior of the wall.

.4 Prior to installation of seals, Contractor to submit proof of training to the Contract Administrator. Do not install the cable seal system without equipment Manufacturer training, as work will have to be re-done. Contact Roxtec for training.

.5 Prior to covering up wall penetration work, arrange for a site inspection of the work with the Contract Administrator. Proof of proper installation is required.

.3 Concrete roof or membrane waterproofed floor:

.1 Provide a watertight seal.

.2 Without concrete encasement: Install watertight entrance seal device on each side.

.3 With concrete encasement: install watertight entrance seal device on the accessible side.

.4 Securely anchor watertight entrance seal device into construction with one or more integral flanges.

.5 Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.

.4 Heating, ventilating, and air conditioning equipment:

.1 Penetrate equipment in area established by Manufacturer.

.2 Connect equipment using liquid tight flexible conduit.

.5 Corrosive sensitive Areas:

.1 Seal all conduit passing through corrosive room walls.

.2 Seal conduit entering equipment panel boards and field panels containing electrical equipment.

.6 Existing or precast wall (underground): core drill wall and install a watertight entrance seal device.

.7 Nonwaterproofed floor (underground, without concrete encasement):

.1 Provide watertight entrance seal device.

.2 Fill space between raceway and sleeve with expandable watertight compound or oakum and lead joint, on each side.

.8 For exterior installations, conduit entry shall be from the bottom, unless approved otherwise by the Contract Administrator.

3.6 Installation - General

.1 Provide bonding conductor in all conduit systems. Verify bond continuity of all conduit systems.

.2 Install conduit concealed, in walls, floors, ceilings, above suspended ceilings, and underground.

.1 Unless otherwise indicated, install conduits surface-mounted on walls and ceilings. Conceal or embed conduits only where indicated.

.2 Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

.3 Conduits shall be sized in accordance with CEC requirements for wire counts installed. Conductors shall be de-rated according to code requirements. Upsize conductors as required to meet CEC and voltage drop requirements.

.1 Except where otherwise required by Canadian Electrical Code (CEC), provide conduit of types specified and sizes indicated on drawings or as specified.

.2 Where sizes are not indicated, select proper sizes to suit intended use, fulfill wiring requirements, and comply with Canadian Electrical Code (CEC).

.3 Minimum conduit size: 21 mm, unless specifically indicated otherwise on the Drawings or specifically approved by the Contract Administrator.

.4 Water/Wastewater Treatment Plant – Conduit Types by Area:

.1 Office, lunch room, and similar dry locations:

.1 EMT conduit.

.2 Chemical Rooms, Corrosive Areas (Category 2):

.1 RPVC conduit.

.3 Hazardous Locations/Areas, and Corrosive Areas:

.1 Underground, and/or in concrete.

.1 Epoxy coated metal conduit (i.e. green-guard or other product type).

.2 PVC coated metal conduit.

.2 Above-grade installations:

.1 Exposed above-grade conduits shall be rigid aluminum, liquid tight, and as required to meet the requirements of the installation. Do not use steel conduit for areas where H2S gas or other corrosive gasses or liquids are present.

.3 Use explosion proof flexible connection for connection to explosion proof motors.

.4 Install conduit sealing fittings, fill with sealing compound and fiber material. Meet all requirements of the CEC with respect to hazardous areas sealing and means and methods. Refer to CEC Section 18 and 22 for additional requirements.

.4 General Locations/Areas and Category 1 (wet), and Heat Trace Systems:

.1 Rigid Aluminum threaded conduit.

.5 General Locations/Areas and dry:

.1 Rigid Galvanized Steel conduit.

.6 Exterior and Outside, Above-grade installations:

.1 Rigid Galvanized Steel conduit.

.5 Where EMT and PVC conduit is used, provide a separate green insulated ground wire in each conduit.

.6 Use liquid tight flexible metal conduit for connection to motors/pumps, vibrating equipment, instrumentation, and luminaries.

.7 Plug conduit ends to prevent entry of dirt and moisture.

.8 Seal conduit with duct seal compound and fibreglass insulation where conduit leaves heated area and enters unheated area.

.9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight and to the minimum fully engaged threads per the CEC for application and Hazardous area.

.10 Install pull cord in all empty conduits.

.11 Emergency lighting and exit signs shall be connected via a separate and dedicated conduit system.

.12 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.13 Dry conduits out before installing wire.

.14 All conduits exposed in finished areas are to be free of unnecessary labels and trade marks.

.15 Seal and firestop penetration around conduit with cUL approved fire stop assembly for the installation conditions.

.16 Where conduit crosses building expansion joints, install expansion fitting approved by Authority Having Jurisdiction, complete with grounding jumper. Provide bend or offset in conduit adjacent to building expansion joint where conduit is installed above suspended ceilings.

3.7 Installations in Category 1 Locations

.1 Arrange to provide drainage at frequent intervals to suitable locations.

.2 Equip with approved fittings to permit the moisture to drain out of the system.

.3 Install the conduit with a minimum of 12 mm space from the supporting surface.

.4 Every joint, coupling and fitting to be water-tight.

.5 Where conduit leaves a warm room and enters a cooler atmosphere, seal the conduit and arrange the conduit in a manner to avoid condensation accumulation at the seal.

3.8 Installations in Category 2 Locations

.1 Comply with all requirements of Category 1 locations.

3.9 Installations in Category 2 Wet Locations

.1 Comply with all requirements of Category 1 locations.

3.10 Installations in Hazardous Locations

.1 Install conduit system, complete with explosion proof conduit sealing fittings:

.1 Install cables in conduit system – maximum permitted conduit / conduit fitting fill for hazardous areas is 25%.

.2 Provide sealing fittings to suit the area classification, and to meet the CEC requirements.

.3 Install sealing compound following Manufacturer's instructions.

3.11 Installation – Metal Conduit and Tubing, Rigid Metal Conduit

.1 Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.

.2 Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

.3 Utilize insulated grounding bushings at all enclosure entries for metallic conduit.

.4 Cut conduit straight with a squared end, properly ream smooth, cut threads and brush threads clean.

.1 Remove burrs, ream and clean metal conduit before installation of conductors, wires, or cables.

.2 Metal, threaded conduit to be cut with a cutting tools that provide a 19mm taper per foot.

.5 Fasten conduit terminations in sheet metal enclosures with two locknuts and terminate with bushing. Install locknuts inside and outside enclosure.

.6 Conduit installed underground shall be painted with two (2) coats of corrosion inhibiting compound before backfilling.

.7 Threaded conduit connections shall have a minimum of five (5 full threads fully engaged or greater. In general all threaded connections (for both hazardous and non-hazardous areas) shall meet or exceed the requirements set out in CEC Section 18.

.8 Provide drain seal in vertical raceways where condensate may collect above sealing fitting.

3.12 Installation – Non-Metallic Conduit

.1 Make field bends and solvent cemented joints in accordance with manufacturer's instructions.

.2 PVC conduit sections and fittings shall be connected using watertight PVC conduit cement.

3.13 Installation – Exposed/Surface and Semi-Concealed Conduit

.1 Run conduits adjacent to or below existing cable tray systems. Use existing strut where available, add strut and threaded rod where existing strut is not available.

.1 Group conduits wherever possible on suspended or surface mounted unistrut channels.

.2 Where conduits pass through walls, group and install through openings. After all required conduits are installed; close wall openings with material compatible with the wall construction. Perform fire stopping & sealing to ensure integrity of wall.

.3 Provide a minimum of 1 conduit diameter of space between adjacent conduit runs.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Install conduit to conserve headroom and cause minimum interference in spaces through which conduit passes.

.4 Install conduit so as not to interfere with ceiling inserts, luminaires or ventilation ducts or outlets.

.5 Alter routing to avoid structural obstructions, keeping crossovers to a minimum.

.6 Install exposed conduit and extensions from concealed conduit systems neatly, parallel with, or at right angles (perpendicular) to walls and structural members.

.7 Run conduit for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.

.8 Run conduits in flanged portion of structural steel.

.9 Do not pass conduits through structural members except as indicated. Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.14 Installation - Concealed Conduits

.1 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.2 Where required to be concealed, install conduit neatly and close to building structure so as to minimize need for furring.

.3 Run parallel or perpendicular to building lines.

.4 Do not install horizontal runs in masonry walls.

.5 Do not install conduits in terrazzo or concrete toppings.

3.15 Installation - Conduits in Cast-In-Place Concrete (On Grade)

.1 Place conduit between bottom reinforcing steel and top reinforcing steel.

.1 Install in centre one third of slab.

.2 Ensure minimum 20 mm concrete cover.

.2 Separate conduit by not less than diameter of largest conduit to ensure proper concrete bond.

.3 Protect conduits from damage where they stub out of concrete.

.4 Install sleeves where conduits pass through slab or wall.

.5 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.

.1 Use cold mastic between sleeve and conduit.

.6 Conduits in slabs: minimum slab thickness 4 times conduit diameter.

.7 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.8 Organize conduits in slab to minimize cross-overs.

3.16 Installation - Conduits in Cast-In-Place Slabs (Below Grade)

.1 Use epoxy coated rigid steel conduits.

.2 Run conduits 25 mm and larger below slab and encase in 75 mm concrete envelope.

.1 Provide 50 mm of sand over concrete envelope below floor slab.

3.17 Installation - Conduits Underground

.1 Minimum burial depths shall be as detailed on the Drawings, but in no case less than the requirements indicated in the CEC.

.2 Conduits shall have a red plastic warning tape placed above, buried at a depth of 305 mm below grade. The plastic tape is to completely cover all conduits, and overlap the width of all conduits by at least 150 mm on either side. Provide mechanical protection, planking in accordance with the U.G trenching specifications.

.3 All underground direct buried conduits shall be rigid PVC.

.4 Provide rigid PVC conduit, type DB2 for encasement in concrete for duct banks. HDPE conduit can be used only where specifically approved by the Contract Administrator.

.5 Maintain a minimum of 1200 mm horizontal clearance distance from underground structures such as buildings and equipment foundations.

.6 Maintain a minimum of 600 mm horizontal clearance distance from underground equipment such as piping and other underground conduit runs.

.7 All clearances in strict accordance with the MBC, CEC, and all other by-laws.

.8 Provide Universal GPS coordinates of all underground conduit runs at every bend, and at every 6000 mm intervals. Include coordinates on the As-Built Drawings.

.9 Provide man-holes and hand-holes as required to accommodate the conductor pull.

.10 Slope conduits away from building and enclosures entry points, to provide drainage.

.11 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

END OF SECTION

CABLE TRAYS FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1 Description

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This section supplements requirements of other Divisions.

.1 Section includes cable tray, cable tray accessories, hangers and supports that may be required for the project and the applications where each type shall be used.

.2 Provide a complete system of cable trays required to fully support all cable and conduit throughout the facility. System shall provide separate trays or barriers for 600 VAC systems, 120 VAC systems, and 24 VDC systems. System shall be complete with all supports and hangers as necessary for the installation.

.1 Where medium voltage (4.16 kV and 12.47 kV) power cables are either required or are existing these tray systems shall be kept separate.

.3 Coordinate the location of the support channels so as not to interfere with other services.

.4 Not all cable tray required is indicated on the Drawings. Provide additional tray as required to fully support all cable and conduit throughout the facility as required under this Contract.

1.2 References

.1 ASTM International (ASTM):

.1 A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

.3 B766: Standard Specification for Electrodeposited Coatings of Cadmium.

.2 Canadian Standards Association (CSA):

.1 C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 C22.2 No. 126.1 - Metal Cable Tray Systems.

.3 C22.2 No. 126.2 - Non-metallic Cable Tray Systems.

.4 HA Series M - CSA Standards for Aluminum and Aluminum Alloys.

.3 National Electrical Manufacturers Association (NEMA):

.1 VE 1 – Cable Tray.

.2 VE 2 – Cable Tray Installation Guidelines.

.3 RV 4 – Application and Installation Guidelines for Service-Entrance Cable.

.4 Manitoba Electrical Code (MEC):

.1 Manitoba amendments to the Canadian Electrical Code.

.5 Underwriters Laboratories (UL):

.1 CAN/ULC-S115, Standard method of fire tests of firestop systems.

1.3 Shop Drawings and Product Data

.1 Submit Shop Drawings and Product data in accordance with Division 1 and Division 26.

.1 Manufacturer's descriptive literature for materials.

.2 Prior to construction, submit design drawings and calculations indicating all tray loading has been reviewed by and bear the stamp of a Professional Engineer registered in the Province of Manitoba.

.3 Literature includes dimensions, misc. materials, finishes, certifications, load ratings, fire stopping systems including cUL/CSA listing and certifications, anchor and connection details, and structural dimensions and materials.

.4 Design drawings shall include but not limited to:

.1 Indicate the various types of cable trays used.

.2 Show actual cable tray installation details and suspension system.

.3 Arrangement and dimensions of mounting fittings and accessories.

.4 Detailed layout plans indicating cable tray locations, sizes, barriers, and structural supports.

.5 Indicate bills of materials for the complete system, including quantities of each tray members.

.5 Design, plan and coordinate cable tray routing to avoid conflicts with other trades. Install trays and raceways generally as indicated on the Drawings. Coordinate this Work with the other trades to ensure adequate horizontal and vertical clearances are maintained.

.1 Cable tray and channel to be suspended at an elevation that will not interfere with other systems – such as lighting, mechanical systems, piping, building structure, etc.

.2 Lighting fixtures shall be mounted adjacent to cable tray systems (i.e. same height), or below. Light fixtures mounted over-top cable tray systems is not acceptable.

.3 Provide additional offsets, bends, etc. as required to adjust cable tray routing and height to avoid conflict with ducts, pipes, beams, etc. Provide 45 degree risers over

or under architectural, mechanical or structural systems where required. Confirm requirements on site and include costs in tender price.

.4 Do not install tray routes and tray supports until the desired routing have been coordinated with other trades. Inform the Contract Administrator of any conflicts and make adjustments as determined by the Contract Administrator.

.6 Testing:

.1 Factory certified test reports of specified products, conforming to CSA C22.2 No. 126.1 and related NEMA standards.

.2 Field test reports indicating and interpreting test results relative to compliance with performance requirements.

.2 Acceptable Manufacturers:

.1 Unitray Systems Inc.

.2 ABB (Thomas & Betts) B-Line Series.

.3 Eaton B-Line Series.

.4 MP Husky Cable Tray & Cable Bus.

.5 Canadian Electrical Raceways Inc (CER).

.6 Enduro Systems, Inc.

.7 Or approved equivalent.

1.4 O&M Manual

.1 Include all Shop Drawings and product submittals.

1.5 Coordination

.1 For cable tray installation coordinate pathways and installations supports with structural work and mechanical ductwork.

.2 Do not support cable tray from other division structural supports without permission from structural engineer.

.3 All trays are shown diagrammatically on the Drawings. Determine the exact location in the field. Install tray runs to prevent interference with process or service piping and ducting and to maintain clearance for tray access. Coordinate the exact location of tray supports and runs with the work of other Divisions.

2. PRODUCTS

2.1 Cable Tray

.1 Use aluminum tray unless indicated on the drawings. Select the Class of Tray based on the methods of cable tray support. Cable tray shall conform to CSA C22.2 No. 126.1 with 228 mm (9") rung spacing, 150 mm (6") side rails and width as required to prevent cable and tray de-rating. The Contractor is responsible for increasing cable sizes due to de-rating factors from cable spacing.

.1 Aluminum ladder type in most areas.

.2 For specific locations where chemical corrosion is a concern (i.e. Chemical Rooms), use 316 Stainless steel tray.

.2 Factory manufactured horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints, reducers and other fittings where required. Field fabricate only those fittings not available from Manufacturer. All direction changes in main runs of cable tray shall be made using standard factory-made fittings.

.1 Radii on fittings: 600 mm minimum, provide Radaii to accommodate the cabling requirements and installation. Minimum cable and channel tray fitting radius shall meet or exceed the minimum bending radius of the cables installed.

.3 Provide stainless steel rod hanger clamps, rod hangers, wall mounting support brackets and all necessary accessories for complete installation.

.4 Barriers where different voltage systems or electrical systems are in the same tray, or as indicated.

.1 Provide barrier to separate 600 V power and control cables from analogue cables when these cables are installed in the same cable tray.

.2 Provide separate cable tray for medium voltage (4.16 kV) power cables.

.3 Fire Barriers in accordance with Division 1 and Division 26.

.5 Cable tray covers shall be solid aluminum covers with a flange and complete with raised cover clips.

.1 Install cable tray cover where mechanical protection of cables is required and all external/outdoor installations. Where covers are required in only the vertical plane these shall be provided to a minimum height of 3 m above grade.

.2 Install covers on trays crossing under open stairways and grating, and for 2 m above floor penetrations.

.6 Cable Spacers:

.1 Recommend suitable space in accordance with manufacturers requirements if spacers are required.

.2 Diameter of opening to be suitable for cable size.

.3 Mounting hardware to be compatible with tray system.

.4 Multi conductor cable feeders to be tied down with adequate tie raps.

.7 Unless otherwise approved by the Contract Administrator, provide cable trays of the same manufacturer throughout the Work.

2.2 Supports

.1 Coordinate with structural system and with other electrical installations, the building manufacturer, or structural engineer. Installations shall only commence after confirming the anticipated weight and attachment locations have been coordinated with the building manufacturer, or structural engineer.

.2 Provide aluminum support members for aluminum cable tray. Provide 316 Stainless steel support members for stainless steel cable tray.

.1 Provide stainless steel rod hangers, washers, bolts, nuts, fittings, rod hanger clamps and accessories as required. Minimum Stainless Steel type AISI 304. Provide all fixing hardware, support hardware, clams and accessories as required.

.3 Design and install the cable tray / cable channel support system suitable for the tray / channel loading class.

.4 Suspend cable trays on rod hangers and hanger clamps or channels spaced as required by loading classification rating and not more than the maximum support spacing on centers as per the Span/Load Class requirements. Fasten hangers to channels securely mounted to the structure. Typical maximum support spacing have been provided Table below from CSA C22.2 No.126. Supports shall be provided as required for the Class, the installation means and methods employed, and all cable tray bends.

.1 CSA class loading as a minimum, must safely handle the weight of the cables installed, must anticipate the weight of approximately 20% future cabling, plus a safety factor. Safety factor on NEMA tray systems is 1.5, and 1.7 for IEC tray systems.

Class	Design Load (kg/m)	Maximum Design Support Spacing (Straight Length) (m)
A	37 kg/m (24.86 lb/ft)	3 m
C1	97 kg/m (65.18 lb/ft)	3 m
D1	67 kg/m (45 lb/ft)	6 m
E	112 kg/m (75.26 lb/ft)	6 m

.5 Fitting supports: All fittings have their own support requirements, refer to NEMA VE2 and the manufacturers literature. Supports shall be selected, designed and installed to accommodate a minimum of three (3) times the tray loading class weight.

.1 Cable tray fittings, expansion joints and the like shall be supported within 600 mm of both sides of such connection. Locate splice plates within 600 mm of a support.

.6 Wall mounted support brackets: Provide aluminum channel strut supports mounted vertically in concrete wall complete with mounting brackets sized to suit cable tray width and loading. Use approved anchor bolts for fastening brackets.

.1 Where a cable tray support is installed at a location greater than 1000 mm from a structural column, the horizontal strut of the cable tray support shall be supported by two structural steel members.

.7 Vertical cable trays shall have cable tray supports spaced at intervals not exceeding 1200 mm and shall be open on one side to facilitate cable pulling.

.8 Supply and install all other tray manufacturer approved accessories, including cantruss guide clamps, support brackets, etc. Provide and install stiffener bars as required.

.9 Where supports cannot be installed due to lack of suitable structural members, the contractor will use longer lengths of cable tray to span between the available structural supports.

.1 This may require the cable tray classification to be adjusted (increased).

.2 This may require Unistrut or other suitable structural means to span across the structural members (typically spanned and fastened between two or more purlins, or joists).

.3 This may require floor Unistrut floor supports in areas where existing HVAC or other large equipment may impede a section of ceiling space. The floor supports shall not interfere with the rules of egress or required working space around equipment.

2.3 Expansion Joints

.1 There are structural expansion joints in the Facility. Provide expansion couplings and fittings for all conduit, tray, etc. crossing the joints. Do not locate rigid devices (for example panels) across or on top of the expansion joints.

.2 The table below has been provided as a minimum requirement for incorporation of expansion joints into the cable tray installation. Where the cable tray manufacturer has posted data indicating the expansion of their product may require additional gap, the more stringent shall apply.

.3 Use expansion-joint splice plates to allow 50 mm free movement between adjacent trays when crossing a building expansion joint.

.4 The table below is provides the Maximum spacing between Expansion Joints that provide for 250 mm (1") Movement.

.1 Where non-metallic tray is installed requiring 16 mm (5/8") movement, multiply maximum spacing between expansion joints by 0.625.

Application Type	Temp Differential* (˚C)	Steel		Alum		Fiberglass	
		(m)	(ft)	(m)	(ft)	(m)	(ft)
Indoor Installation	14	156	512	79	260	203	667
	28	78	256	40	130	102	333
	42	52	171	27	87	68	222
	56	39	128	20	65	51	167
Outdoor Installation	70	31	102	16	52	41	133
	83	26	85	13	43	34	111
	97	22	73	11	37	29	95
* Temperature Differential is the difference in temperature between the hottest and coldest days of the year.							

2.4 Cable Channel

.1 Ventilated trough type.

.2 Channel: Aluminum for process and office areas, with the exception of: use 316 stainless steel within the chemical building and for any exterior cable tray runs. Provide the required width and depth of channel to accommodate the required cabling.

.3 Cable channel bonds shall be a minimum #6 AWG, stranded, copper conductor connected to each section with a Manufacturer approved grounding/bonding lug, in accordance with CEC requirements. Upsize bond conductor to account for cable ampacity in accordance with CEC table 16.

3. EXECUTION

3.1 Installation

.1 Install in accordance with Manufacturer's requirements, in accordance with NEMA VE2, in accordance with the Drawings, and as required by the Final Design. Install tray to be accessible at all locations.

.2 The Drawings indicate general concepts, and may not show all details required for mounting or installation. Supply and install any additional items required for a complete and working installation.

.1 Install cable tray of the size and type as specified on the Drawings and as required for cable routing. The Drawings show main cable tray routes only – they do not show all required cable channels to individual pieces of equipment. Provide cable channel (even though not explicitly shown on the Drawings) to route cables to specific equipment.

.2 Where a common tray is shown on Drawings, separate the cables for different voltage classes from each other by metal barriers as supplied by the tray Manufacturer.

.3 Provide a cable tray system for three (3) or more cables when cable lengths exceed 3 m.

.4 Size cable trays as indicated on Drawings and per the Cable Tray system design. If any discrepancies are found or changes in tray size are required, advise the Contract Administrator before installing the tray systems.

.5 The cable installation shall adhere to CEC requirements with respect to cable spacing and cable de-rating factors. De-rating shall be in accordance with CEC table 5C and 5D. Cables shall be installed uniformly across the width of the tray to minimize the number of layers and in accordance with CEC de-rating factor requirements.

.6 Provide minimum vertical clearance above the trays as per the CEC or as indicated on the Drawings.

.7 The installation shall be parallel or perpendicular to the building structure / grid lines and shall be installed straight, plumb and true unless otherwise shown on the Drawings. Where two or more trays run the same route, make parallel and ensure offsets and bends are uniform.

.3 Construct and use approved platforms, scaffolding and rigging systems for installation and access. The use of cable trays as walkways, "ladders", or structural rigging supports is not permitted.

.4 Maintain spacing between cables of different systems and voltages. Install barriers within cable trays to separate systems.

.5 Ensure that the cable / channel trays and supports are properly aligned with a minimum of distortion.

.6 Provide metal cable clamps (approved for use by the tray manufacturer) bolted to the side of the tray for all cables entering or exiting the cable tray.

.7 Cable tray sections shall be saw cut as required. Cut sections shall be square, de-burred, and drilled for standard factory splice plates. Cutting by welding or burning is not permitted.

.8 Do not allow or cause any work performed or installed to be covered up or enclosed prior to the required inspections, tests and approvals.

.9 Cables in Cable Tray:

.1 Install cables individually.

.2 Lay cables into cable tray to provide a minimum of cable crossovers.

.3 Secure cables in cable tray at 6 m centres with nylon ties.

.4 The air space between cables shall be 100% of the largest conductor diameter or unless otherwise specified. Provide a minimum of 20% space area in all cable tray systems.

.10 Suspend cable trays on rod hangers and hanger clamps or channels spaced as required by loading classification rating and spaced not more than the maximum allowed for the Tray

class, elbow, or fitting requirements on centers. Fasten hangers to channels securely mounted to the structure.

.1 Do not drill through wood ceiling trusses. Provide wood blocking on top of ceiling truss to anchor rod hangers and channels.

.2 Where hanger threaded rods are used, use stainless steel and not be smaller than 12 mm in diameter to trapeze style hangers. Trapeze style members shall be supported by a minimum of two (2) threaded rods, the member material shall match the supported Tray system, with a minimum member diameter of 41 mm x 41 mm.

.3 Where threaded rod does not line up with the structural attachment points above, provide strut to span between two or more purlins. Cantilevered strut is not acceptable.

.11 Provide minimum 600 mm horizontal clearance on one side of cable tray throughout.

.12 Install tray systems in such a manner as to conserve headroom and minimize the use of free space through which they pass. Maintain a minimum 2,100 mm clear headroom wherever possible.

.13 When the ends on square strut channel type shelf brackets are below 2100 mm AFF in a walking area, cut flush with tray. Permanently cap the end of square strut channels, etc. with plastic caps. Suitably protect sharp corners and edges of tray to prevent personal hazard.

.14 Provide a green PVC-insulated bonding conductor of 4/0 AWG stranded tin plated copper on tray throughout the entire length of each tray run. Attach bonding conductor to tray at minimum every 15 m with approved ground wire clamps and anti-oxidizing compound, and at each isolated segments of tray (i.e. separate joints, fittings, tray sections etc.). Bonding conductor insulation to be FT4 rated for indoors and FT1 rated for outdoors. For trays stacked vertically above each other (maximum of three trays in stack), provide a bonding conductor throughout the entire length of one tray with bonding jumpers at a minimum of every 15 m from that tray to the other tray(s) in the tray stack, and at each isolated segments of tray. Solidly connect each tray run to the electrical room ground bus.

.1 All cable tray sections shall be bonded, using the building frame as a path to ground is unacceptable.

.2 For tray installed in hazardous areas, wet or corrosive areas: green insulated jacket.

.3 For trays installed in dry, non-corrosive, non-hazardous areas: bare copper.

.4 Supply and install tray manufacturer approved ground wire clamps for ground wire connection onto tray members.

.15 Check all trays for surface smoothness prior to installation and remove all debris, burrs, ridges, foreign material etc. on all tray surfaces facing or in contact with the cabling. Remove sharp edges. Cut ends or defaced surfaces shall be painted or as directed by the Contract Administrator.

.16 Repair or restore to original condition, any equipment or structure damaged during installation or before final acceptance at no additional cost.

.17 Restore to original condition any painted surfaces damaged during installation at no additional cost.

3.2 Barriers and Separations

.1 Provide barriers where different low voltage systems (600V and lower) are in same cable tray, and separation when entering or leaving the tray system. Cables shall be spaced in accordance with the following table from the City of Winnipeg's Electrical Design Guide.

.2 Supply and install tray manufacturer approved conduit to cable tray adapters for transitions from a conduit system onto the tray.

Cable	**Other Cable**	**Minimum Segregation**	**Notes**
Communication – Fibre	Communication	None	
	Instrumentation / Control < 50 V	None	
	Other	Separate Raceway	To reduce risk of physical damage to fibre cable.
Communication – Copper	Instrumentation / Control < 50 V	50 mm	
	120 VAC, 8 AWG or smaller	100 mm	
	120 VAC, > 8 AWG	300 mm	
	600 VAC Power	300 mm	
	VFD or other high harmonic cable	300 mm	Metallic conduit
		600 mm	Other raceway
	Medium Voltage – 3C armoured and shielded	300 mm	May be in metallic conduit instead of armoured.
	Medium Voltage – 1C or 3C unshielded	450 mm	
Instrumentation (Analog)	Control < 50 V	None	
	120 VAC, 8 AWG or smaller	100 mm	
	120 VAC, > 8 AWG	300 mm	
	600 VAC Power	300 mm	
	VFD or other high harmonic cable	300 mm	Metallic conduit
		600 mm	Other raceway
	Medium Voltage – 3C armoured and shielded	300 mm	May be in metallic conduit instead of armoured.
	Medium Voltage – 1C or 3C unshielded	450 mm	
Control < 50 V	120 VAC, 8 AWG or smaller	50 mm	
	120 VAC, > 8 AWG	300 mm	
	600 VAC Power	300 mm	
	VFD or other high harmonic cable	300 mm	Metallic conduit
		450 mm	Other raceway

Cable	Other Cable	Minimum Segregation	Notes
	Medium Voltage – 3C armoured and shielded	300 mm	May be in metallic conduit instead of armoured.
	Medium Voltage – 1C or 3C unshielded	450 mm	
120 VAC Control	120 VAC, 8 AWG or smaller	none	
	120 VAC, > 8 AWG	Metal barrier or 150 mm	
	600 VAC Power	Metal barrier or 150 mm	
	VFD or other high harmonic cable	150 mm	Metallic conduit
		300 mm	Other raceway
	Medium Voltage – 3C armoured and shielded	300 mm	May be in metallic conduit instead of armoured.
	Medium Voltage – 1C or 3C unshielded	450 mm	
120 VAC Power	600 VAC Power	Metal barrier	
	VFD or other high harmonic cable	150 mm	Metallic conduit
		300 mm	Other raceway
	Medium Voltage – 3C armoured and shielded	300 mm	May be in metallic conduit instead of armoured.
	Medium Voltage – 1C or 3C unshielded	450 mm	
600 VAC Power	VFD or other high harmonic cable	100 mm	Metallic conduit
		150 mm	Other raceway
	Medium Voltage – 3C armoured and shielded	150 mm	May be in metallic conduit instead of armoured.
	Medium Voltage – 1C or 3C unshielded	300 mm	

.1 For cables with voltages above 600 V, run cabling on separate cable trays, grouped according to the voltage level.

.2 Covers for cable trays for all exterior run cable trays. For cable trays interior to buildings, provide covers where shown on the Drawings.

3.3 Cables in Cable tray

.1 Install cables individually.

.2 Lay cables into cable tray. Use rollers when necessary to pull cables.

.3 For horizontal cabling secure cables in tray at intervals not more than 1.5 m in accordance with Rule 12-2202 6).

.4 For vertical cabling provide support clamps for cables in tray at intervals not exceeding those specified in Table 21. For distances less then those found in Table 21, at minimum a support clamp shall be provided at the top of the waterfall and again at the bottom of the waterfall. Between the provided support clamps, approved ties shall be provided in intervals not exceeding 1.2 m.

.1 Tie wraps are not permitted to support cables in vertical sections of cable tray, support must be provided in accordance with CEC Rule 12-120. Tie wraps may be used in horizontal sections of cable tray to maintain cable spacing.

3.4 Cables In Cable Channel

.1 Install cables individually.

.2 Lay cables into cable channel.

.3 For horizontal cabling secure cables in channel at intervals not more than 1.5 m.

3.5 Floor/Wall Seal Systems

.1 Coordinate openings with other disciplines for the required penetration width and depth of cable tray to pass through as required.

.2 All penetrations shall be sealed tight.

.3 Provide system to allow for cable re-entry to allow for future work.

.4 Indoor penetrations shall be trimmed flush, outdoor penetrations shall be provided with a metal cover over the entire outdoor exposed tray system.

.5 For all fire rated walls/floors/ceilings, provide fire stopping that complies with a tested cUL system arrangement to suit the fire rating required for the penetrations. Opening size/type and size of penetrating items shall be within the range specified within the cUL system detail. Fire blocks and stopping systems shall be protected from Ultraviolet (UV) radiation and water by at least a 7 mm thick coating of firestop elastomeric sealant.

.6 For non fire-rated walls, the sealant shall equal the wall thickness. The material shall be heat and UV stable.

3.6 Identification

.1 Identify cables with nameplates in accordance with Division 26.

.2 Mark power and communication cables in accordance with colour coding outlined in Division 26.

.3 Provide yellow placards with black lettering on each tray section indicating the existing and maximum weight capacities:

CAUTION – BUILDING LIMITATION
*EXISTING CABLE WEIGHT LOADING IN THIS TRAY: _____ kg/m
**MAXIMUM CABLE WEIGHT LOADING IN THIS TRAY: _____ kg/m

*Where the cable tray system also supports other electrical installations, include these weights plus the weights of the cabling.

**Where the building manufacturer or structural engineer does not provide a weight limit for the tray system, the maximum design load for the class of tray shall be used.

END OF SECTION

1. GENERAL

1.1 Description

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This section supplements requirements of other Divisions.

.1 Section includes various materials for underground works that may be required for the project and the applications where each type shall be used.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 CSA C22.3 No.7, Underground Systems.

.3 CSA Z809, Sustainable Forest Management, and Update No. 1.

.2 Forest Stewardship Council (FSC):

.1 FSC-STD-01-001 V5-2, FSC Principle and Criteria for Forest Stewardship.

.3 Sustainable Forestry Initiative (SFI):

1. SFI Standards and Rules.

.4 Winnipeg Electrical By-law (WEB):

.1 Winnipeg amendments to the Canadian Electrical Code (CEC).

.5 Winnipeg Building By-law (WBB):

.1 Winnipeg amendments to the National Building Code of Canada (NBC).

1.3 Submittals

.1 Submit in accordance with Division 1 and Division 26.

.2 Submittals shall include, but not be limited to the following:

.1 Submit manufacturer's instructions, printed product literature and data sheets for cables and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Precast manholes and handholes.

.3 Dimension drawings and descriptive literature.

.4 Cable pulling calculations for all cables.

.5 Proposed cable pulling methodology to ensure pulling forces are within the cable Manufacturer's limits.

2. PRODUCTS

2.1 Cable Protection

.1 Wooden Protection: 38 x 140 mm planks pressure treated with copper naphthenate or 5% pentachlorophenol solution, water repellent preservative. Must be rated Permanent Wood Foundation (PWF), All Weather Wood (AWW) is not acceptable. Creosote and some other types of wood preservatives may injure the insulation of conductors and should not be used.

.2 Concrete Topping Protection: Concrete topping of conduit in trench, minimum 50 mm thick layer of concrete, dyed red, with a 150 mm overhang, past the edges of each conduit installed for the length of the trench.

.3 For underground conduits or cables, provide mechanical protection as follows:

.1 120 V or 600 V and 15 A to 90 A: mechanical protection using treated planks 600 V and below; and 100 A or greater: mechanical protection using 50 mm thick concrete topping, or concrete duct banks as directed on the Drawings.

.2 600 V to 15 kV: mechanical protection using 50 mm thick concrete toping, or concrete duct banks as directed on the Drawings.

2.2 Markers

.1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

.2 Cedar post type markers: 89 x 89 mm, 1.5 m long, treated with copper naphthenate or 5% pentachlorophenol preservative, with nameplate fastened near post top, on side facing cable or conduit to indicate depth and direction of duct and cable runs.

.1 Nameplate: aluminum, anodized 89 x 125 mm, 1.5 mm thick mounted on cedar post with mylar label 0.125 mm thick with words Cable, Joint or Conduit with arrows to indicate change in direction. Fasten using stainless steel screws.

.3 Warning tape:

.1 Material: Polyethylene, 4-mil gauge with detectable strip.

.2 Color: Red.

.3 Width: Minimum 150 mm.

.4 Designation: Warning on tape that electric circuit is located below tape.

.5 Identifying Letters: Minimum 25 mm high permanent black lettering imprinted continuously over entire length.

.6 Manufacturers and Products:

.1 Panduit; Type HTDU.

.2 Reef Industries; Terra Tape.

.3 W.H. Brady Inc.

.4 Wieland Electric Inc.

3. EXECUTION

3.1 General

.1 Prior to excavation or directional boring, perform a complete site survey to ensure that the installation will not conflict with existing systems. Repair of damages to existing systems will be at the cost of the Contractor.

.2 Provide Universal GPS coordinates of all underground cable or conduit runs at every bend, and at a maximum of 6000 mm intervals. Include coordinates on the As-Built Drawings.

.3 Coordinate work with other trades to ensure that the location and route of the buried systems does not conflict with the work of other trades.

.4 Refer to the Drawings for cable / trench details where applicable. Where conflict in details occurs, allow for the more onerous and costly installation method.

.5 Perform all utility and underground locates, include “Call before you dig” (now Click-before-you-dig) to ensure all utilities are located/flagged: http://clickbeforeyoudigmb.com/

.6 Clearances to be in strict accordance with the Winnipeg Electrical Bylaws (WEB), CEC, and all other applicable by-laws.

3.2 Directional Drilling/Boring

.1 Perform directional boring as directed on the Drawings, or as specifically approved by the Contract Administrator. Otherwise, use open trenching installation methods.

.2 Directional boring shall utilize HDPE conduit.

3.3 Direct Burial of Cables

.1 Employ soft dig excavation methods near and around any buried electrical system. An acceptable soft dig method is Hydrovac (water based) excavation method.

.2 All cable / conduit trenches shall have a red plastic warning tape placed above, buried at a depth halfway between grade and the installation. The plastic tape is to completely cover all conduits and overlap the width of all conduits by at least 150 mm on either side. Use multiple parallel tape runs as required.

.3 Perform excavation and trenching. Provide sand bed in trench, and lay in cables, maintaining separation between cable runs. Maintain a minimum of 75 mm of clearance from each side of trench to the nearest cable. Do not pull cable into trench.

.4 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.5 Minimum permitted radius at cable bends for rubber or plastic cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or greater in accordance with the Manufacturer's instructions. For communications cables minimum permitted radius is 15 the diameter of the cable or greater in accordance with the Manufacturer's instructions.

.6 Underground cable splices are not acceptable.

.1 Make terminations and splices (splices - only where specifically approved by the Contract Administrator) leaving 0.6 m of surplus cable in each direction. Terminations and splices shall be performed with approved kits, and in accordance with the Manufacturer's instructions and with specific training.

.7 Maintain a minimum of 150 mm horizontal separation between power cabling, increase to 190 mm separation if cabling is 1/0 or larger. For cables of different circuits add an additional 75 mm minimum separation.

.1 Maintain a minimum of 300 mm horizontal separation between power cabling and communication cabling.

.2 Maintain 300 mm (190 mm only where specifically approved by the Contract Administrator) minimum separation between power cabling from different sources/transformers.

.3 Maintain 300 mm minimum horizontal separation between low voltage (<100 0V) and medium voltage cables (>1000 V).

.4 Where possible, communication cables should have a minimum horizontal separation of 1000 mm from water and sewer lines and other deep services.

.8 Cable Crossing:

.1 Cable crossing shall be made at right angles (or as close to right angles as possible), with mechanical protection.

.2 Minimum burial depths shall be maintained per CSA C22.1 (Table 3) and CSA C22.3 No. 7 (Table 1). Increase the depth of cabling systems in a crossing to maintain minimum vertical separation, and minimum burial depth. Provide mechanical protection(s) as required.

.3 Provide sand bed over cables, after the cables are laid into the trench. Minimum sand bedding below cables is 75 mm. Minimum sand bedding above cables is 75 mm. Supply and install mechanical protection of cables above sand bedding. Use clean fill, devoid of rocks or materials which can damage or deform the cable trench.

.4 When low voltage cables (<1000 V) cross medium/high voltage cables (>1000 V) maintain 300 mm vertical separation with low voltage cables in upper position.

.1 When mechanical protection is provided, maintain a minimum 75 mm vertical separation between low voltage cables and 150 mm between medium/high voltage cables.

.5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control, cables when crossing other cables, with fire alarm and control cables in upper position.

.6 The Contractor must meet the minimum code clearance requirements when crossing of any other systems, such as mechanical or utility services.

.9 Mechanical Protection:

.1 Install pressure treated wood (PTW) planks on lower cables 600 mm horizontally in each direction at crossings.

.2 When intersecting other utilities and watermain (WM) works, provide horizontal mechanical protection between the services (i.e. if the WM is deeper, provide horizontal mechanical protection below the electrical service (i.e. sand layer). If the intersecting utility is above the electrical installation then the additional mechanical protection shall be provided above the electrical installation.

.3 Provide horizontal mechanical protection above conduits/cables for any location less than 1 m in burial depth. When horizontal protection is used above cabling systems it shall be provided at a minimum depth of 300 mm below finished grade. The minimum depth for the electrical installation when mechanical projection is provided above shall be buried 0.7 m below finished grade. Provide PTW a minimum of 100 mm thick.

.4 Provide vertical mechanical protection between trenches for any location where the horizontal distance between trench or other utility/services is less than 1 m (300 mm min with protection), or horizontal distance between a trench and light/utility pole or tree is less than 2 m (1.5 m min with protection), or horizonal distance between the trench and under ground structure (building or equipment foundation) is less than 1.2 m (300 mm min with protection). The minimum vertical height shall equal or exceed the sand layer when adjacent to utility/services, however, when adjacent to a light/utility pole it shall extend the height of the trench.

.1 Clarification: Reduction of horizontal separation between the trench and utility/services shall be coordinated with the utility/service prior to reducing separation distance. In some cases reduction may be approved by the utility/service, in other cases the full separation distance must be adhered to.

.10 Backfill:

.1 Use clean backfill, free of rocks and debris. Return excavation area to the original condition.

.2 Photograph all open trenches, with cabling, conduit, supports and spacers installed.

.3 Do not cover cabling or backfill until inspected by the Authority Having Jurisdiction (AHJ), and Contract Administrator. Do not close up trench without approval.

3.4 Cable Installation in Ducts

.1 Do not pull spliced cables inside ducts.

.2 Inspect and clean ducts prior to installing cables.

.3 Group raceways installed in same area.

.4 Utilize conductors that are rated for underground direct earth burial in underground ducts.

.5 Before pulling cable into ducts and until cables properly terminated, seal ends of cables with moisture seal tape.

.6 Install multiple cables in duct simultaneously.

.7 Use CSA-approved lubricants of type compatible with cable jacket to reduce pulling tension.

.8 Install cables as indicated in ducts.

.9 Provide expansion fittings that allow minimum of 100 mm of movement in vertical conduit runs from underground where exposed conduit will be fastened to or will enter building or structure. Provide slack loops in cable, compatible expansion fittings.

.10 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.

.11 After installation of cables, seal duct ends with duct sealing compound.

.12 Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

.13 Install watertight fittings in outdoor, underground, or wet locations.

3.5 Markers

.1 Mark cable every 30 m along cable or duct runs and changes in direction or as indicated on the Drawings.

.2 Where markers are removed to permit installation of additional cables, reinstall existing markers.

3.6 Field Quality Control

.1 Perform tests in accordance with Division 26.

.2 Check phase rotation and identify each phase conductor of each feeder.

.3 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.4 If Voltage Drop (VD) measurements are taken for any reason during construction for any cabling that is part of an underground system, the value shall only be deemed valid in summer at a minimum ground temperature of 25°C.

.5 Pre-acceptance test.

.1 After installing power cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.3 Provide Contract Administrator with list of test results showing location at which each test was made, circuit tested and result of each test.

.4 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.7 Clean-up

.1 Repair damage to adjacent materials caused by cables installation.

.2 Repair surface to previous existing condition, or to new conditions specified on the Drawings, and in the Specifications.

END OF SECTION

1. GENERAL

1.1 Description

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This Section supplements requirements of other Divisions.

.1 Section includes various equipment and testing requirements that may be required for the project and the applications where each type shall be used, this section also partially overlaps the Fractional Horsepower Motors specification.

.2 Low voltage electric motors and accessories, furnished under other Sections, and which are a part of equipment assemblies (including pumps) shall be in conformance with the requirements specified in this Section, unless otherwise noted. This section includes performance, and descriptive type specifications.

.1 All items of electrical equipment that are furnished with process, heating, ventilating, or other equipment shall conform to the requirements specified under the applicable electrical sections of the Division 26 Specifications. Enclosures for electrical equipment such as switches, starters, etc., shall also conform to the requirements specified under the applicable electrical sections of the Division 26 Specifications.

.3 Unless otherwise specified or approved, all electric motors furnished and installed by the Contractor shall conform to the requirements specified herein.

.1 Motors connected to variable frequency drives shall be inverter-duty rated in accordance with the requirements of NEMA MG 1.

.2 Three phase motors rated 0.75 kW and larger shall be of the premium efficiency, “Design E”, type per Table 12.1 of NEMA MG1 Part 12. Motors shall have a NEMA Nominal Efficiency not less than the values referenced in NEMA MG1. Efficiency values shall be based on tests performed in accordance with IEEE Publication No. 112, Method B. Motors with horsepower or motor speeds not listed shall conform to comparable standards of construction and materials as those for listed motors.

1.2 References

.1 American Bearing Manufacturers Association (ABMA).

.2 American National Standards Institute (ANSI), Hydraulic Institute (HI):

.1 ANSI/HI 9.6.3, The Rotodynamic (Centrifugal and Vertical) Pumps – Guideline for Allowable Operating Region.

.3 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

.1 90.1, Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings.

.4 Canadian Standards Association (CSA):

.1 CSA C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 CSA C22.2 No. 100, Motors and Generators.

.3 CSA C22.2 No. 145, Electric motors and generators for use in hazardous (classified) locations (Tri-national standard with NMX-J-652-ANCE and UL-674).

.5 National Electric Manufacturers Association (NEMA):

.1 MG 1, Motors and Generators.

.6 Institute of Electrical and Electronics Engineers (IEEE).

.1 112, Standard Test Procedure for Polyphase Induction Motors and Generators.

.2 114, Standard Test Procedure for Single-Phase Induction Motors.

.3 1349, Guide for the Application of Electric Motors in Zone 2 and Class 1, Division 2 Hazardous (Classified) Locations.

1.3 Submittals

.1 Submittals in accordance with Division 1 and Division 26.

.2 Shop Drawings and descriptive data to include:

.1 Descriptive literature and motor characteristics.

.2 Complete list of all motors and their associated Tags to be furnished.

.3 Outlines, dimensions, weights, and wiring diagrams.

.1 Overall dimensions of motor.

.2 Shaft centreline to base dimension.

.3 Shaft extension diameter and keyway, coupling dimensions and details.

.4 Fixing support dimensions.

.5 Dimensioned position of ventilation openings. Details of ventilation duct attachments.

.6 Arrangement and dimensions of accessories.

.7 Location of main and accessories boxes with size of conduit entrance.

.8 Location of horizontal and vertical drains.

.4 Mounting Plate type and size.

.5 Terminal box location and size of terminals.

.6 Starting current and relative data necessary for use in design of motor starting equipment.

.7 Speed/torque characteristic.

.8 Routine tests shall be performed on representative motors and shall include the information described on NEMA MG 1-12.61. Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors. Include efficiency and power factor at 1/4, 1/2, 3/4 and full load.

.9 Motor nameplates shall be stainless steel. Include data for NEMA Standard MG1, as applicable. Permanently fasten nameplate to motor and position for easy inspection.

.10 Strip heaters kW and voltage ratings.

.11 Power factor correction capacitors, where required.

.12 Built in overload protection device.

.13 Starting restrictions, acceleration time-current curve of motor starting load (100 hp and larger).

.14 Thermal damage curve and allowable stall time, full voltage (100 hp and larger).

.15 Installation and maintenance data.

.1 Bearing design data, grease requirements and part numbers.

.16 Shop test reports.

.17 Submit Pump, Motor and VFD, if applicable for a complete review; Coordination Certificates.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into O&M.

.2 Data necessary for maintenance of motors.

.3 Field acceptance test reports.

.4 Manufacturer's recommended list of spare parts.

2. PRODUCTS

2.1 Materials

.1 Motors:

.1 Non-hazardous locations: to CSA C22.2 No. 100.

.2 Hazardous locations: to CSA C22.2 No. 145.

2.2 Finish Painting and Corrosion Prevention

.1 Provide equipment resistant to corrosion from severe moisture conditions.

.2 Unless otherwise specified, motors shall be given a shop application of paint filler or enamel sealer, a flat coat of undercoater for enamel, and two coats of enamel or, in lieu of this treatment, other corrosion-resistant treatment customary with the manufacturer.

2.3 Electric Motor Ratings

.1 As indicated on Drawings or in the Specifications.

.2 Motors shall comply with NEMA MG1, unless otherwise specified.

.3 HVAC Applications: Meets the energy efficiency requirements of ASHRAE 90.1 Table 10.

.4 All polyphase non-explosion proof motors shall be designed for energy efficient operation and meet the requirements of MG 1-12.53 a and b.

.5 Voltage ratings:

.1 Unless otherwise specified, motors with ratings of 0.37 to 261 kW (0.5 to 350 hp) shall be rated 600 V (nameplate rating), three-phase, 60 hertz; motors 0.25 kW or less to be rated 115 V, single-phase, 60 hertz.

.2 High-voltage motors, if indicated on Drawings, shall be specified elsewhere in the Specifications.

.6 The following specific motor requirements shall be in the equipment specifications:

.1 Motor speed.

.2 Motor enclosure type.

2.4 Design Letters and Application

.1 Every motor shall be of sufficient capacity to operate the driven equipment under all load and operating conditions without exceeding its rated nameplate current or power or its specified temperature limit at rated voltage. Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10% below nameplate rating. Where indicated on the electrical drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.

.2 The motor shall have sufficient capacity to operate the driven equipment as given in the equipment detail specifications. The motor shall not be required to deliver more than its rated nameplate horsepower, at unity (1.0) service factor, under any condition of mechanical or hydraulic loading.

.3 Motor suitable for driving centrifugal pumps, fan blower, compressor, or gears as indicated or required for the application.

.4 All motors shall having starting characteristics and ruggedness as may be necessary under the actual conditions of operation and, unless otherwise specified, shall be suitable for full-voltage starting.

.1 In addition, motors shall be rated inverter duty for any variable frequency drive (VFD) or soft starter applications.

.2 Inverter duty rated: Motors for operation on variable frequency drives shall meet performance standards in NEMA MG 1, Part 31. Enclosures shall be equal to those furnished for severe duty or explosion proof motors. Motor shaft and bearings shall be insulated. Internal service factor shall be 1.15 that of the nameplate. Ventilation system shall be designed for maximum heat transfer. Stator laminations shall be stagger-stacked and stamped from high grade electrical steel to minimize eddy-current losses and heat build-up caused by inverter induced harmonics. Rotors shall be configured to minimize skin-effect heating.

.5 Submersible motors shall be manufacturer's standard.

.6 Hermetically sealed air conditioning units, elevators, hoists, cranes and other devices complying with special safety codes shall be furnished with motors, control equipment, accessories and safety devices for approved, safe, and efficient operation, in accordance with the manufacturer's standards and to be rated for the duty cycle as specified for the driven equipment. Minimum service factor 1.15 above 2.25 kW.

.7 Chemical duty motors shall be provided with severe duty rating.

.8 For 3-phase motors:

.1 Three-phase motors shall not be provided with starting capacitors.

.2 All three-phase motors shall be provided with a 1.15 service factor.

.3 All three-phase two-speed motors shall be of the two-winding design.

.4 Design B for typical applications such as machine tools, fans, blowers, centrifugal pumps, and misc. pumps.

.5 Design C for typical applications such as machine compressors, string machines, agitators, reciprocating pumps, crushers, and conveyors.

.6 Design D for typical applications such as punch presses, flywheels (such as punch presses, shears, elevators, extractors, winches, hoists), oil-well pumping, and wire drawing machines.

.9 For 1-phase motors:

.1 Design L type (<= 1HP), and Design M type (>= 1.5 HP) and/or suitable for the application:

.1 Single-phase motors requiring switching devices and auxiliary starting resistors, capacitors, or reactors shall be furnished as combination units with such auxiliaries either incorporated within the motor housings or housed in suitable enclosures mounted upon the motor frames. Each combination unit shall be mounted upon a single base and to be provided with a single conduit box.

.2 Permanent Split Capacitor (PSC) type for typical applications such as direct-drive fans, and blowers.

.3 Split-Phase type for typical applications such as belt-drive and direct-drive fans and blowers, small tools, centrifugal pumps, and appliances.

.4 Capacitor-Start type for typical applications such as pumps, compressors, tools, conveyors, farm equipment, and industrial ventilators.

2.5 Enclosure Types

.1 Motors shall have a steel or cast-iron frame and a cast iron or stamped steel conduit box, as specified below. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover. Motor leads shall be sealed with a non-wicking, non-hygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 6 mm diameter, shall be provided inside the conduit box for motor frame grounding.

.2 Chemical duty motors shall be of the corrosion resistant type conforming to motors designated by the manufacturer as Corro-Duty, Mill and Chemical, Custom Severe Duty, or similar quality designation. Severe duty motors shall have a cast iron frame, cast iron end brackets, cast iron conduit box and 1.15 service factor at 40°C and tapped drain holes (corrosion resistant plug for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger).

.3 Vertical motors of the open type shall be provided with drip hoods of acceptable shape and construction. When the drip hood is too heavy to be easily removed, provision to be made for access for testing.

.4 Totally enclosed motors shall be provided with automatic breather and drain.

.5 Includes lifting eyes or lugs.

.6 Ordinary Location (i.e. clean, and dry locations):

.1 Open drip proof fully guarded (ODP).

.7 Category 1 Wet Area, Non-Hazardous Area (i.e. where dirt or dampness exists):

.1 Totally enclosed non-ventilated (TENV):

.1 Lighter load equipment.

.2 TENV motors shall include the same rating and accessories as specified for TEFC motors.

.2 Totally enclosed fan cooled (TEFC):

.1 Heavier load equipment. Used on pumps, compressors, fans, and other belt-driven and direct connected equipment.

.2 TEFC motors shall have a steel or cast-iron frame, cast iron end brackets, cast iron conduit box, 1.15 service factor at 40°C, tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and upgraded insulation by additional dips and bakes to increase moisture resistance.

.8 Hazardous Area (Category 1, Category 2 Area):

.1 Explosion proof motors shall comply with all requirements for the hazardous locations as defined by the CEC and with all other safety codes pertaining thereto.

.2 Totally enclosed explosion proof for use in the following hazardous locations:

.1 Gases: Class I Division 1,2 Group A, B, C, D. (Class 1 Zone 0, 1, 2).

.2 Dusts: Class II Division 1, 2 Group E, F, G. (Class 1 Zone 20, 21, 22).

.3 Fibers: Class III Division 1, 2 (Class 1 Zone 20, 21, 22).

.4 Enclosure to house Temperature switch for monitoring enclosure surface temperature.

.5 The Temperature switch shall be set such that a temperature exceeding 80% of the auto-ignition temperature of the specific gas, vapor, or fiber in the area where the equipment is intended to be used shall shut down the motor.

2.6 Performance Characteristics

.1 As required on the Drawings or Specifications.

.2 The Contractor shall furnish the Contract Administrator with five (5) certified copies of characteristic curves of each motor furnished, except 115 V motors. Curves shall be supplied as a part of the driven equipment submittal.

2.7 Insulation

.1 All motors shall have Class B or Class F insulation with temperature rise by resistance at full load rating of a Class B insulation in accordance with NEMA MG 1, and based on a maximum ambient temperature of 40°C unless otherwise specified.

.2 Insulation systems shall be manufacturer’s premium grade, resistant to attack by moisture, acids, alkalis and mechanical or thermal shock for 600 V motors. Provide 80°C, Class B rise or better by resistance at 100% load and provide a Class F insulation system, suitable for an ambient temperature motor operation of 0 to 40°C at no more than 1000 m above sea level for inverter duty motors. This temperature rise shall be met when motors are operated and controlled with the VFD(s). The motor insulation system shall have full capability to handle the common mode voltage conditions imposed by the VFD.

.3 Motor windings shall be braced to withstand successfully the stresses resulting from the method of starting. The windings shall be treated thoroughly with acceptable insulating compound suitable for protection against moisture and slightly acid or alkaline conditions.

.4 Motors for outdoor service shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.

.5 Insulation for inverter duty motor windings shall meet or exceed the Pulse Endurance Index for magnetic wire and shall not be injured when exposed to repeated pulse type waveforms, repetitive high voltage transients, switching frequency and rate of rise of the pulse. Class H varnish shall be used.

2.8 Bearings

.1 Antifriction type bearings, fitted with readily accessible facilities for lubrication while motor running or stationary.

.2 Vertical motors shall be provided with thrust bearings adequate for all thrusts to which they can be subjected in operation.

.3 Bearings shall be of the self-lubricating type, designed to ensure proper alignment of rotor and shaft and to prevent leakage of lubricant.

.1 Bearings for open motors shall be of the sleeve or ball type, as specified under the respective items of mechanical equipment.

.2 Bearings for totally enclosed and explosion proof motors shall be of the ball type.

.3 Bearing minimum L-10 fatigue life at 100% load shall be 50,000 hours.

.4 Bearing grease shall be of the 120°C thermal capability type.

.4 Hazardous areas/locations: Insulated bearings shall be utilized in hazardous applications where motors are run from VFDs or soft starters. Include bonding/grounding kits.

2.9 Shaft

.1 Standard shaft extension.

2.10 Motor terminal boxes and leads:

.1 Terminate winding connection necessary for appropriate starting method and identify in motor terminal box.

.2 Motors shall be furnished with oversize conduit terminal boxes to provide for making and housing the connections, and with flexible leads of sufficient length to extend for a distance of not less than 100 mm beyond the face of the box. The size of cable terminals, and terminal box conduit hoses shall be as permitted by the Contract Administrator. An acceptable type of solderless lug to be furnished. Totally enclosed and explosion proof motors to have cast-iron terminal boxes.

.3 Leads for space heaters shall be brought out into an auxiliary, cast, conduit box on the motor side opposite to the main terminal box. Auxiliary box to have 50 mm (1 inch) threaded conduit openings and shall be so constructed that conduit entrance may be placed at top, bottom, or either side.

.4 A grounding terminal shall be provided in the main terminal box and a bronze grounding bolt to be furnished at the conduit side of the motor frame.

2.11 Accessories

.1 Shaft extension: as necessary for accessories.

.2 Brake as identified on the Drawings or in the Specifications: electrically operated.

.3 Motor heaters shall be supplied on all motors installed outdoors or in unheated areas. Heaters shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 V, single phase with wattage as required. The heater wattage and voltage shall be embossed on the motor nameplate.

.4 Accessories: suitable for use in same hazardous location as the specified for motor.

.5 Include anchor devices and setting templates.

2.12 Extra Materials

.1 Provide maintenance materials and spare parts in accordance with Division 1.

.2 Furnish one (1) spare bearing of each type for each motor size and type.

2.13 Motor Shop Tests:

.1 Motor shop tests shall be made in accordance with the IEEE Test Codes as specified in the NEMA MG 1. NEMA report-of-test forms to be used in submitting test data.

.2 Motor efficiency shall be determined by use of IEEE Standard 112 Test Method B, and by use of MG 1-12.53 a and b.

.3 For induction motors larger than 75 kW, complete tests of each motor furnished to be made and certified tests data sheets to be submitted, unless witness shop tests are required by the technical specifications pertaining to the equipment. Each motor shall be tested at rated voltage for: efficiency and power factor at 25, 50, 75, and 100% of it rated horsepower; for temperature rise, torque, no-load current, starting current, full load current, and dielectric strength; and for compliance with all specified performance requirements.

.4 For induction motors 3.75 kW up to and including 75 kW, copies of routine tests reports of electrically duplicate motors shall be furnished.

.5 Test data not required for motors 2.25 kW or less.

2.14 Delivery, Storage, and Handling

.1 Shipping:

.1 Ship motors assembled to driven equipment complete except where partial disassembly is required by transportation regulations or for protection of components.

.2 Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

.3 Deliver spare parts at same time as associated devices. Deliver to City after completion of Work.

.2 Receiving and Storage:

.1 Inspect and inventory items upon delivery to Site.

.2 Store and safeguard equipment and material in heated storage facility as recommended by equipment manufacturer and required by Section 01 65 00.

.3 Protect motors from moisture at all times.

.3 Prolonged Storage:

.1 For extended outdoor storage, remove motors from equipment and store separately.

.2 If storage is anticipated to be longer than two (2) months, store in accordance with the manufacturer instructions including the following additional steps.

.3 Keep motor space heaters energized.

.4 Fill the oil reservoirs of motors with sleeve bearings to the proper level with the specified oil.

.5 Motors with anti-friction bearings to receive an initial change of grease and then be re-greased every six (6) months.

.6 Remove the motor shaft braces and the rotate motor shaft every two (2) weeks. Replace the shaft braces prior to relocation to the installation site. Under no circumstances should the motor be lifted without the braces in place.

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 Dry out motor if dampness is present in accordance with manufacturer's instructions.

.2 Install motor rigid plumb and square, using only lifting facilities provided.

.3 Make wiring connections.

.1 Use liquid tight PVC jacketed flexible conduit between rigid conduit and motor.

.2 Make flexible conduit long enough to permit movement of motor over entire length of slide rails.

.4 Check for correct direction of rotation, with motor uncoupled from driven equipment.

.5 Align and couple motor to driven machinery to manufacturer's instructions, using only correct parts such as couplings, belts, sheaves, as provided by manufacturer.

3.3 Field Quality Control

.1 Perform tests in accordance with Division 26.

.2 Ensure the motor operates as intended during testing of the individual equipment and during process commissioning. Perform testing in accordance with Division 26.

END OF SECTION

1. GENERAL

1.1 References

.1 NETA Acceptance Testing Specifications, 2009 (ATS-2009).

.2 CSA C282, Emergency Electrical Power Supply for Buildings.

.3 City of Winnipeg inspection.

1.2 Submittals

.1 Provide submittals in accordance with Section 01 33 00, Submittal Procedures.

.2 Submit:

.1 Test equipment to be utilized with last calibration date.

.2 Qualifications of lead electrical inspections technician.

.3 Test forms that will be utilized. These will be based on the COW test form format.

1.3 Qualification

.1 Provide competent lead electrical inspection technician thoroughly familiar with all aspects of electrical testing. It is expected that the technician will have a CET, Journeyman Electrician's certificate, or other equivalent designation. The designated technician is to be on-site and lead all electrical testing.

.1 The Contract Administrator reserves right to approve the lead electrical inspection technician and request an alternate technician if deemed to be unqualified.

.1 The Contract Administrator reserves the right to request documentation and proof from the Contractor that their lead electrical inspections technician is qualified to perform the work. The documentation and proof can include the following:

.2 A request for references from past previous projects.

.3 A request for a list of past previous projects.

.2 In the circumstance where the Contract Administrator rejects the lead inspection technician, the Contractor will be responsible for providing a suitably qualified individual to perform the work, at no additional cost to the City of Winnipeg. Qualifications will be specifically analyzed by the Contract Administrator, based on the following:

.1 The qualified lead electrical inspection technician will have performed similar work at other similar installations.

.2 The qualified lead electrical inspection technician will be trained in using the instruments and measuring devices; and adjusting the settings or programming the devices.

.3 The qualified lead electrical inspection technician will have experience in analyzing the results obtain from the instruments or measuring devices.

.4 The qualified lead electrical inspection technician will have sufficient experience to immediately recognize erroneous measurements based on past work experience and expected results.

.5 The qualified lead electrical inspection technician will be familiar with the settings and methodologies required to perform the Work.

.3 In the circumstance where the Contractor cannot provide a competent lead electrical inspection technician, the Contract Administrator reserves the right to hire a qualified individual separate from this Contract and to back charge the Contractor for services and costs performed in order to complete the Work.

1.4 Testing Equipment

.1 All test equipment shall be in good mechanical and electrical condition.

.2 Accuracy of metering in test equipment shall be appropriate for the test being performed.

.3 Wave shape and frequency of test equipment output waveforms shall be appropriate for the test and the tested equipment.

.4 The test equipment shall be calibrated as specified below:

.1 The testing organization shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.

.2 The testing organization will have calibration certifications for test equipment, and a copy will be made available to the Contract Administrator.

.3 The firm providing calibration service shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.

.4 Instruments shall be calibrated in accordance with the following frequency schedule:

.1 Field instruments: Analog, six (6) months maximum. Digital, twelve (12) months maximum.

.2 Laboratory instruments: twelve (12) months maximum.

.3 Leased specialty equipment: twelve (12) months maximum.

.4 Dated calibration labels shall be visible on all test equipment.

.5 Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.

.6 Calibrating standard shall be of higher accuracy than that of the instrument tested.

.5 Specific requirements of insulation resistance meters.

.1 Must be digital units.

.6 All test equipment to have valid calibration stickers displayed on the equipment.

.7 DC High Pot (dielectric strength) Units:

.1 Test instrument to have minimum output of 60 kV DC capacity.

.2 120 VAC powered.

.8 AC High Voltage (dielectric strength) Units:

.1 Use AC High voltage units for insulation tests and other tests as indicated, at voltage levels indicated, or required by Manufacturers recommendations.

.9 Low Resistance Test Units (Ductor):

.1 Low resistance test units to have 10 A output.

.2 Digital display and accuracy to 1 micro-ohm, with a range from 1 μΩ to 1000 Ω. Standard electrician multimeters will not be accepted.

.10 Insulation Resistance Tests (Megohmmeter/Megger):

.1 Use a megger with 20,000 M-ohm resolution for megger tests.

.2 Output voltages on DC megger units to be 250V, 500V, 1000V, 2500V or other as required.

.3 Record ambient temperature and adjust the measured M-ohms to 20°C ambient.

.4 Use 2.5 kV megger for 5 kV and15 kV equipment and 1000 V megger range for power equipment of 600 V and below.

.5 For 10-minute megger tests, record M-ohm values in M-ohm at 30 seconds, 60 seconds, 5 minutes and 10 minutes. Plot M-ohm against time for each connection, calculate and record the ratio of measured M-ohm as follows:

.1 60 sec M-ohm/30 sec M-ohm = dielectric absorption.

.2 10 min M-ohm/1 min M-ohm = polarization index.

.3 Report the 1 minute M-ohm as the insulation resistance value.

.6 Submit tabulated measure M-ohm figures for 10-minute insulation tests, submit a graph.

.7 Apply megohmmeter dc voltage in accordance with the equipment Manufacturer's recommendations or NETA ATS-2009 Table 100.1.

.11 VLF Test:

.1 Use a VLF tester capable of 40 kV peak that is capable of testing 1.1uF of cable load at 0.1 Hz up to 5.5 uF at 0.2 Hz.

.12 Relay Test Equipment:

.1 Relay test equipment to be designed for relay testing, secondary current injection.

.2 Current output to a minimum of 60Amps for testing of instantaneous features.

.3 Indicators to detect open signals, pick-up signals and other required signals.

.4 Timers to 1 millisecond.

.5 For equipment required on three phase systems, have a three phase voltage and relay output test unit.

.6 For equipment required on three phase differential tests, have a six phase voltage and relay output test unit.

.13 Ground Resistivity Tester:

.1 Ground resistivity tester to measure earth impedance in variable distances from the source.

.2 Unit to be capable of plotting ground resistivity from 0.1 ohms and up.

.14 Other test equipment as required in order to satisfy the requirements of this section as detailed herein.

1.5 Testing Report

.1 Prepare an overall inspection and test report that details all investigations and tests.

.2 The Contractor shall provide final report.

.1 The electronic copy of the report, including the test forms, shall be provided in PDF format.

.2 Sample City test forms are included for reference. The Contractor shall modify the forms, and create new forms as needed to meet all the test requirements described herein.

.3 A Microsoft Word version of the all completed test forms will be provided to the City.

.3 The report shall be neat and organized. Any omissions, inconsistencies, or incomplete work identified by the Contract Administrator shall be corrected and incorporated into the report in the appropriate section, and completely resubmitted.

.4 A draft of each report shall be completed and sent to the Contract Administrator for review a maximum of one (1) month after the completion of the inspections at the Site.

.5 The final report shall be submitted a maximum of two (2) weeks after the Contractor receives the mark-up of the draft report from the Contract Administrator.

.6 The report shall include the following:

.1 Summary of project.

.2 Testing Equipment.

.3 Detail the type, manufacturer, model, last calibration date and test certificate for all testing equipment used.

.4 Description of equipment tested.

.5 Description and methodology of all tests performed.

.6 Typed inspection forms including:

.1 Identification of the testing organization.

.2 Equipment identification.

.3 Humidity, temperature, and other conditions that may affect the results of the tests/calibrations.

.4 Date of inspections, tests, maintenance, and/or calibrations.

.5 Identification and signed initials of the testing technician.

.6 Indication of inspections, tests, maintenance, and/or calibrations performed and recorded, along with charts, and graphs as applicable. All measurements and readings taken shall be noted for inclusion in the report. Where repairs are made, measurements and readings before and after the repair shall be included.

.7 Indication of expected results, when calibrations are to be performed.

.8 Indication of “as-found” and “as-left” results, as applicable.

.7 Itemized list of all repaired deficiencies which shall include:

.1 Detailed description of the deficiency.

.2 Detailed description of the deficiency repair.

.8 Itemized list of all un-repaired deficiencies encountered which shall include:

.1 Detailed description of the deficiency.

.2 Recommended action to be taken to repair the deficiency.

.3 Reason for not performing the recommended repair (such as equipment or component not available).

.4 Schedule and subsequent follow up and documentation of the repair of the deficiency.

2. PRODUCTS

2.1 Equipment

.1 Provide all tests results with typed test reports and signed field test sheets.

.2 All test sheets to include equipment nameplate data, customer identification, time and date of tests, environmental conditions during tests, and test results.

.3 Provide testing equipment, lifts, man-baskets, temporary connections, cabling, lugs, leads, clips, and all other devices and equipment as required to perform the required tests and complete the required documentation.

3. EXECUTION

3.1 Test Plan

.1 Prior to performing testing, the lead electrical inspection technician shall submit written test procedures indicating details of the work to be performed to the Contract Administrator for review and approval prior to proceeding.

.2 As a minimum, the test plan shall include the following:

.1 Type of tests.

.2 Equipment being used to perform the test.

.3 Equipment settings for each test.

.4 Test sheets.

.5 Safety checks and safety plan.

.6 An indication of expected results.

.3 The cost of any damage to equipment due to improper test methods or procedures will be borne by the Contractor performing the tests.

3.2 Scope of Testing

.1 Perform testing and Commissioning of electrical devices, in accordance with the Drawings and Specifications to suit the actual project. Scope of work for testing includes the following devices:

.1 Motor Control Centers (MCCs), including:

.1 Surge Protector.

.2 Power Meter.

.3 Voltage Monitor.

.4 CTs.

.5 PTs (if present).

.6 Main and Tie Breakers.

.7 Branch Circuit Breakers.

.8 Motor Starters.

.9 VFDs.

.10 Interlocks.

.11 Kirk keys.

.2 Panelboards and distribution panels, greater than 225A, including:

.1 Surge Protector.

.2 Power Meter.

.3 Voltage Monitor.

.4 CTs.

.5 PTs.

.6 Branch Circuit Breakers.

.3 Static Uninterruptible Power Supply (UPS).

.4 Molded case circuit breakers, greater than or equal to 250 A frame.

.5 Contactors, greater than or equal to 100 A.

.6 Protective relays.

.7 Dry type transformers, 15 kVA and greater.

.8 Oil filled transformers.

.9 Motors, 0.5 HP and greater.

.10 Safety switches, greater than 200A.

.11 Battery systems.

.12 Surge arrestors.

.13 VFDs.

.14 Cables:

.1 Test all 120 / 208 V / 240 V / 600 V power cables and wires No. 10 AWG or larger (except for lighting and 15A duplex receptacle circuits).

.2 Test all 15 kV cables.

.15 Grounding system.

.16 Perform harmonics measurements and analysis at all main distribution panels, and at all MCCs at all available voltage levels at the Facility.

.2 All equipment which fails the tests shall be replaced, repaired and corrected at no additional charge. These items are deemed to be under warrantee, and the warrantee shall not be affected or voided as a result of the testing performed.

.3 The calibration, check out, testing and Commissioning activities specified in other sections, of the overall Specifications are to be considered as supplemental to the requirements of this section. Those requirements are to be completed for each particular part of the work described prior to the execution of the overall requirements described herein. Where any duplication in requirements may exist the more stringent requirement will take precedent.

.4 Perform Commissioning of all systems, to ensure a complete and functional installation. Perform Commissioning work in accordance with Appendix A – Commissioning Specification and Objectives (CSO), and Appendix B – Commissioning Procedures (CP), of this document.

3.3 Inspection, Testing and Maintenance Procedures

.1 General:

.1 All tests are based on NETA (InterNational Electrical Testing Association) standard ATS-2009. Where Manufacturer's Specifications, tolerances, and/or published data are not available, refer to the appropriate tables in ATS-2009. Confirm with the equipment

Manufacturer that the test will not damage the equipment or void the warrantee prior to proceeding with tests.

.2 Torque all accessible bolted electrical connections. Additional requirements apply as specified.

.3 Utilize the Drawings for reference while performing the specified electrical inspection work. Where the existing installation deviates from that shown on the Drawings, mark-up the Drawings with red pen as required to reflect the installation. Include the marked-up Drawings in the report.

.4 The scope of required Drawing checks is limited to the equipment and components that are part of the electrical inspection work.

.5 Any repairs made that affect the accuracy of the Drawings shall be marked up on the Drawings.

.6 All inspection values, readings, corrections, and assessments shall be clearly recorded for inclusion within the report.

.7 Where corrections or repairs are made, record both as found/as left test readings on the inspection sheet. If space is not provided on the inspection form, record the readings in the Note fields or on a separate sheet.

.2 Inspection Forms:

.1 The inspection forms are to be provided, and completed by the Contractor. These shall be typewritten (in Microsoft Word or Excel format) and submitted the Contract Administrator for format approval.

.2 Make appropriate print-outs of the inspection forms and utilize for entry of data and test results on Site.

.3 Utilizing the Microsoft Word form templates, enter the data recorded manually into the forms electronically.

.4 Complete the inspection forms in their entirety and include them in the report.

.5 Submit electronic PDF copies of the inspection forms.

.6 The scope of work required in the Specifications is in no way limited by the inspection forms, or spaces provided. Provide additional pages, documents, and forms as required to provide a complete report.

.7 The inspection forms may be updated during the by the Contract Administrator. Utilize the latest forms.

.8 Perform insulation resistance temperature correction.

3.4 Cables (Also Feeders In Conduit), Up To 600 V

.1 Perform inspection and tests on cables prior to installing sealing compound in the conduit system. This applies to hazardous areas and to weatherproof penetration sealant.

.2 Inspection and testing shall be comprised of the following:

.1 For cables/wires 4/0 AWG or larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate and correct values which deviate from those of similar bolted connections by more than 50% of the lowest value.

.2 Torque all accessible bolted electrical connections.

.3 Inspect compression applied connectors for correct cable match and indentation.

.4 Inspect grounding and cable/conduit support.

.5 Verify that visible cable bends meet or exceed the minimum allowable bending radius.

.6 Measure length of cable/conduit and record in meters. Record and adjust all cable lengths included in the cable schedules. Other building base building cabling such as lighting, fire alarm, public address, 15A duplex receptacles do not need to be recorded. Record cable lengths based on conductor distance markings where ever possible, for accurate lengths.

.7 If cables/wires are terminated through window-type current transformers, inspect to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.

.8 Perform an insulation-resistance test on each conductor. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 1 Gigohms for power cabling. The voltage applied shall be 1000 Vdc for 600 V or 1000 V rated cables.

3.5 Cables, Medium Voltage (5 kV and 15 kV)

.1 Inspection and testing shall be comprised of the following:

.1 Inspect exposed sections of cables for physical damage and evidence of overheating and corona.

.2 Proper connections in accordance with single-line diagram.

.3 Proper circuit and phase identification.

.4 Inspect terminations and splices for physical damage and evidence of overheating and corona.

.5 Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar

connections. Investigate values which deviate from those of similar bolted connections by more than 50% of the lowest value.

.6 Inspect compression applied connectors for correct cable match and indentation.

.7 Check for proper lug installation.

.8 Confirm bolt torque levels are in accordance with Manufacturer's recommendation.

.9 Inspect shield grounding and cable support.

.10 Verify that visible cable bends meet or exceed the minimum allowable bending radius.

.11 Measure and record the length of cable.

.12 If cables are terminated through window-type current transformers, inspect to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.

.13 Perform a shield-continuity test on each power cable by ohmmeter method. The shielding must exhibit continuity. Investigate resistance values in excess of 10 ohms per 1000 feet of cable.

.14 Perform an insulation-resistance test on each conductor utilizing a megohm-meter:

.1 Utilize 2,500-volt megohmmeter for 5 kV, 8 kV, 15 kV conductors in accordance with NETA standards.

.2 Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 5 Gig-ohms for 5 kV cable, and 15 Gig-ohms for 15 kV.

.15 Perform a Very Low Frequency (VLF) ac high-potential test on cables. Adhere to all precautions and limits as specified in the applicable NEMA / ICEA Standard for the specific cable. Perform tests in accordance with IEEE Standard 400.2. Test procedure shall be as follows, and the results for each cable test shall be recorded as specified herein. The test voltage shall be sinusoidal with a frequency of 0.1 Hz, and shall not exceed cable Manufacturer's test values or IEEE 400.2 values as indicated:

Cable rating phase to phase (RMS)	**Acceptance test phase to ground**	**Maintenance test phase to ground**
5 kV RMS	10 kV RMS (14 peak)	7 kV RMS (10 peak)
15 kV RMS	20 kV RMS (28 peak)	16 kV RMS (22 peak)

.1 If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the over-potential test, the test specimen is considered to have passed the test.

.2 Ensure that the input voltage to the test set is regulated.

.3 Current-sensing circuits in test equipment shall measure only the leakage current associated with the cable under test and shall not include internal leakage of the test equipment.

.4 Record wet and dry-bulb temperatures or relative humidity and temperature.

.5 Test each section of cable individually.

.6 Individually test each conductor with all other conductors grounded. Ground all shields.

.7 Terminations shall be adequately corona-suppressed by guard ring, field reduction sphere, or other suitable methods as necessary.

.8 Ensure that the maximum test voltage does not exceed the limits for terminators specified in IEEE Standard 48 or Manufacturer's Specifications.

.9 Raise the conductor test voltage to the specified maximum test voltage and hold for five minutes. Record leakage current.

.10 Apply grounds for a time period adequate to drain all insulation-stored charge.

.16 Perform a Dissipation Factor (Tangent Delta) test on all cables.

.1 Perform tests in accordance with IEEE Standard 400.2.

.2 The test voltage applied shall be a 0.1 Hz sinusoidal waveform.

.3 The dissipation factor shall be calculated for an applied voltage of 1 Uo RMS.

.4 Provided that the dissipation factor does not rise significantly while raising the voltage, the dissipation factor shall also be calculated for an applied voltage 2 Uo RMS.

.5 In the event of a cable failure discovered during testing, replace the cable.

3.6 Circuit Breakers, Insulated-Case/Molded Case, Up To 600 V

.1 Inspection and testing shall include the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Record all adjustable settings.

.3 Inspect physical and mechanical condition.

.4 Inspect anchorage and alignment.

.5 Clean the unit.

.6 Torque all accessible bolted power connections.

.7 Operate the circuit breaker to insure smooth operation.

.8 Test all breakers utilizing the “Push-To-Trip” button, if equipped.

.9 Move operating handle to the off and on position.

.10 Restore breaker position to original position.

.2 For cables 4/0 AWG and larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50% of the lowest value.

.3 For breakers with a frame size greater or equal to 250 A, or as specified elsewhere in the Specification:

.1 Perform an insulation resistance test.

.2 Breakers rated less than 600 V, test voltage is to be 500 VDC.

.3 Breakers rated at 600 V, test voltage is to be 1000 VDC.

.4 Perform a contact/pole-resistance test.

.5 Electrical Tests:

.1 Insulation Resistance Tests:

.1 Utilize:

.1 1,000 volt megohmmeter for 600 V circuit breakers.

.2 Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.

.3 Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.

.4 Test values to comply with NETA ATS-2009 Table 100.1.

.2 Contact Resistance Tests:

.1 Contact resistance in microhms across each pole.

.2 Investigate deviation of 50% or more from adjacent poles and similar breakers.

.3 Dieletric Withstand Tests:

.1 Maximum applied voltage for equipment in accordance with NETA ATS-2009, Table 100.2 and Table 100.19.

.2 Each pole-to-ground with other poles grounded and contacts closed.

.3 Test results evaluated on pass/fail basis.

.4 Minimum pickup voltage tests on trip and close coils.

3.7 Contactor Panels, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Verify the unit is clean.

.5 Torque all accessible bolted power connections.

.6 Inspect unit for evidence of overheating or stress.

.7 Visually inspect and exercise transfer switch.

.2 If power and/or control fuses are present, record fuse size and type. Measure the resistance of each fuse. Investigate inconsistent resistance values.

.3 Perform an insulation resistance tests.

.1 Units rated less than 600 V, test voltage is to be 500 VDC.

.2 Units rated at 600 V, test voltage is to be 1000 VDC.

.4 Perform a contact/pole-resistance tests.

.5 Perform functional testing to verify operation of unit.

3.8 Control Power Transformers, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Record the equipment nameplate data for inclusion in the report.

.2 Inspect physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

.3 Verify that primary and secondary fuse ratings or circuit breakers match available Drawings. Where Drawings are not available, note fuses that appear to be sized incorrectly, based upon application of the Canadian Electrical Code. Mark fuse sizes and type on the Drawings, where not shown.

.4 Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be:

.1 windings less than 250 V: 500 VDC.

.2 windings greater than 250 V: 1000 VDC.

3.9 Current Instrument Transformers

.1 Inspection and testing shall be comprised of the following:

.1 Inspect physical and mechanical condition.

.2 Record the equipment nameplate data for inclusion in the report.

.3 Ensure that CT shorting bars are removed or installed as required.

.4 Verify that current circuits are grounded and have only one grounding point in accordance with ANSI/IEEE C57.13.3.

.5 Perform an insulation resistance test of the current transformer primary and secondary windings, and wiring to ground at 1000 VDC. Do not perform this test on solid-state devices. Investigate any resistance values less than 25 megohms.

.6 Perform a polarity test of each current transformer in accordance with ANSI/IEEE C57.13.1.

.7 Perform a ratio-verification test using the voltage or current method in accordance with ANSI/IEEE C57.13.1. Note any ratio accuracies not within 0.5% of nameplate or Manufacturer's published data.

.8 Perform an excitation test on transformers used for protection or relaying applications in accordance with ANSI C57.13.1.

3.10 Grounding System

.1 Inspection and testing shall be comprised of the following:

.1 Perform resistance tests between the main grounding electrode and grounded points in the electrical distribution system located in the switchgear, transformers, and MCCs. Investigate and correct connections with a resistance greater than 0.5 milliohms.

.2 Perform resistance tests between the main grounding electrode and grounded points in the isolated ground system points in all control / PLC cabinets connected to the isolated ground system. Investigate and correct connections with a resistance greater than 0.5 milliohms.

.3 Perform resistance tests between the lightning protection terminals (at roof level) and the grounding electrode. Investigate and correct connections with a resistance greater than 0.5 milliohms.

3.11 Protective Relays

.1 Visual and Mechanical Inspection:

.1 Visually Check Each Relay For:

.1 Tight cover gasket and proper seal.

.2 Unbroken cover glass.

.3 Condition of case shorting contacts if present.

.4 Circuit wiring and connections.

.2 Mechanically Check Each Relay For:

.1 Freedom of movement.

.2 Proper travel and alignment.

.3 Trip plunger mechanism.

.3 Verify That Each Relay:

.1 Complies with Contract Documents and application.

.2 Is set in accordance with recommended settings.

.2 Electrical Tests:

.1 Tests on Nominal Recommended Setting For:

.1 Perform tests to suit the type of relay and the type of protection in accordance with NETA ATS-2009.

.2 Pickup parameters on each operating element.

.3 Timing at three points on time-current curve.

.4 Pickup target and seal-in units.

.5 Special tests as required to check operation of restraint, directional, and other elements in accordance with Manufacturer's instruction manual and NETA standards.

.2 Phase angle and magnitude contribution tests on differential and directional relays after energization to vectorially verify proper polarity and connections.

.3 Current Injection Tests:

.1 For entire current circuit in each section.

.2 Secondary injection for current flow.

.3 Test current at each device.

.4 For Motor protection Relays and similar relays, use 3-phase current injection for unbalanced protection testing, unless recommended otherwise by the Manufacturer.

.5 Use 6 phase current injection and voltage relay (3 phase line, 3 phase load) test units for differential protection relays.

3.12 Metering Devices, Digital

.1 Inspection and testing shall be comprised of the following:

.1 Inspect physical and mechanical condition.

.2 Torque all bolted connections.

.3 Record the equipment nameplate data for inclusion in the report.

.4 Verify accuracy of voltage and current at a minimum of two points each.

.5 If required, calibrate meters in accordance with Manufacturer's published data.

3.13 Panelboards, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Clean the unit.

.5 Inspect breakers and verify mechanical operation by exercising all circuit breakers.

.1 Record breaker data on the inspection form.

.2 Test all breakers utilizing the "Push-To-Trip" button, if equipped.

.3 Move operating handle to the off and on position.

.4 Restore breaker position to original position.

.6 Test with current injection, main and feeder/load breakers with a frame size greater than or equal to 250A, or with long, short, or ground fault settings and complete a separate inspection form for each.

.7 Torque all accessible bolted power connections including incoming, load neutral and ground connections.

.8 Perform insulation-resistance tests on each bus phase with all other phases grounded.

.1 The main breaker, if present, is to be open for the test. If no main breaker is present, disconnect the supply conductors.

.2 Open all load breakers.

.3 Test voltage for all 600/347 V panelboards to be 1000 VDC.

.4 Test voltage for all 120/208 V panelboards to be 500 VDC.

3.14 Motor Control, up to 600 V

.1 Visual and Mechanical Inspection:

.1 Proper barrier and shutter installation and operation.

.2 Proper operation of indicating and monitoring devices.

.3 Proper overload protection for each motor.

.4 Improper blockage of air-cooling passages.

.5 Proper operation of drawout elements.

.6 Integrity and contamination of bus insulation system.

.7 Check Door and Device Interlocking System By:

.1 Closure attempt of device when door is in OPEN position.

.2 Opening attempt of door when device is in CLOSED position.

.8 Check Key Interlocking Systems For:

.1 Key captivity when device is in CLOSED position.

.2 Key removal when device is in OPEN position.

.3 Closure attempt of device when key has been removed.

.4 Correct number of keys in relationship to number of lock cylinders.

.5 Existence of other keys capable of operating lock cylinders; destroy duplicate sets of keys.

.9 Check Nameplates for Proper Identification of:

.1 Equipment title and tag number with latest one-line diagram.

.2 Pushbuttons.

.3 Control switches.

.4 Pilot lights.

.5 Control relays.

.6 Circuit breakers.

.7 Indicating meters.

.10 Verify that fuse and circuit breaker sizes and types conform to the Drawings.

.11 Verify that current and potential transformer ratios conform to the Drawings.

.12 Check Bus Connections for High Resistance by Low Resistance Ohmmeter, Calibrated Torque Wrench Applied to Bolted Joints and Thermographic Survey:

.1 Ohmic value to be zero.

.2 Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by Manufacturer.

.3 Thermographic survey temperature gradient of 2°C, or less.

.13 Check Operation and Sequencing of Electrical and Mechanical Interlock Systems By:

.1 Closure attempt for locked open devices.

.2 Opening attempt for locked closed devices.

.3 Key exchange to operate devices in OFF-NORMAL positions.

.14 Verify performance of each control device and feature furnished as part of the motor control center.

.15 Control Wiring:

.1 Compare wiring to local and remote control, and protective devices with elementary diagrams.

.2 Check for proper conductor lacing and bundling.

.3 Check for proper conductor identification.

.4 Check for proper conductor lugs and connections.

.16 Exercise active components.

.17 Inspect Contactors For:

.1 Correct mechanical operations.

.2 Correct contact gap, wipe, alignment, and pressure.

.3 Correct torque of all connections.

.18 Compare overload heater rating with full-load current for proper size.

.19 Compare, fuse, motor protector, and circuit breaker with motor characteristics for proper size.

.20 Perform phasing check on double-ended motor control centers to ensure proper bus phasing from each source.

.2 Electrical Tests:

.1 For units with solid state components, follow Manufacturer's recommendations prior to performing any tests.

.2 Insulation Resistance Tests:

.1 Applied megohmmeter DC voltage.

.2 Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.

.3 Contactor phase-to-ground and across open contacts for 1 minute on each phase.

.4 Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.

.5 Test values to comply with NETA ATS-2009, Table 100.1.

.3 Current Injection Through Overload Unit at 300% of Motor Full-Load Current and Monitor Trip Time:

.1 Trip time in accordance with Manufacturer's published data.

.2 Investigate values in excess of 120 seconds.

.4 Control Wiring Tests:

.1 Apply secondary voltage to control power and potential circuits.

.2 Check voltage levels at each point on terminal boards and each device terminal.

.5 Operational test by initiating control devices to affect proper operation.

.6 Verify the correct operation of the network cabling, network switch, and associated components within Smart MCCs.

.1 Verify I/O and metering data from each Intelligent Overload.

3.15 Motors, Induction, AC, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging. Air baffles and filter media should be clean. Cooling fans should operate. Slip ring wear and brushes should be within Manufacturer's tolerances for continued use. Brush rigging should be intact.

.5 Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50% of the lowest value.

.6 Verify the application of appropriate lubrication and lubrication systems.

.7 Verify the absence of unusual mechanical or electrical noise or signs of overheating.

.8 Perform a rotation test to insure correct shaft direction.

.9 Perform insulation-resistance tests in accordance with ANSI/IEEE Standard 43. Test voltage shall be in accordance with Manufacturer's published data or 500 VDC.

.1 Where possible, test each winding separately. Ground all windings not under test.

.2 Ensure all cables and accessories are disconnected during the test.

.3 For motors less than or equal to 150 kW (200 HP), the test duration is to be one (1) minute. Calculate the dielectric absorption ratio.

.4 For motors greater than 150 kW (200 HP), the test duration is to be ten (10) minutes. Calculate the dielectric absorption ratio and polarization index.

.5 Correct test results to 40°C.

.6 Investigate readings below 100 megohms. Investigate dielectric absorption ratios less than 1.4 and polarization index ratios less than 2.0 for Class B insulation and Class F insulation.

.10 Where it is not possible to perform an insulation resistance test separately on each winding, perform a winding resistance test on each winding using a low-resistance ohmmeter.

.11 Measure running voltage and current and evaluate relative to load conditions and nameplate full-load amperes. Utilize a true RMS meter.

.1 Where powered by a VFD with bypass, perform test with the motor powered by the VFD and by the bypass starter.

.12 Perform insulation-resistance test on insulated bearings in accordance with Manufacturer's published data, if applicable.

.13 Perform resistance tests on resistance temperature detector (RTD) circuits. RTD circuits should conform to design intent and/or machine protection device Manufacturer's Specifications.

3.16 Safety Switches, up to 600 V

.1 Visual and Mechanical Inspection:

.1 Proper blade pressure and alignment.

.2 Proper operation of switch operating handle.

.3 Adequate mechanical support for each fuse.

.4 Proper contact-to-contact tightness between fuse clip and fuse.

.5 Cable connection bolt torque level in accordance with NETA ATS-2009, Table 100.12.

.6 Proper phase barrier material and installation.

.7 Verify that fuse sizes and types correspond to one-line diagram.

.8 Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing where installed.

.2 Electrical Tests:

.1 Insulation Resistance Tests:

.1 Applied megohmmeter DC voltage.

.2 Phase-to-phase and phase-to-ground for 1 minute on each pole.

.3 Insulation resistance values equal to, or greater than, ohmic values established by Manufacturer.

.2 Contact Resistance Tests:

.1 Contact resistance in microhms across each switch blade and fuse holder.

.2 Investigate deviation of 50% or more from adjacent poles or similar switches.

3.17 Motor Starters, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the motor / equipment nameplate data for inclusion in the report.

.2 Record all adjustable settings, size of overload, etc.

.3 Ensure overloads are set in accordance with the motor nameplate data, and the electrical code requirements.

.4 Inspect physical and mechanical condition.

.5 Inspect anchorage, alignment, and grounding.

.6 Verify the unit is clean.

.7 Torque all accessible bolted power connections.

.8 Inspect contactors for evidence of overheating or stress.

.9 Visually inspect and exercise circuit breaker.

.10 If power fuses are present, record fuse size and type. Measure the resistance of each fuse. Investigate inconsistent resistance values.

3.18 Motor Starters, Soft Starter, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the motor / equipment nameplate data for inclusion in the report.

.2 Confirm soft starter parameters.

.3 Ensure all parameters are correct for the specific motor nameplate.

.4 Record size and setting of overload.

.5 Inspect physical and mechanical condition.

.6 Inspect anchorage, alignment, and grounding.

.7 Verify the unit is clean.

.8 Torque all accessible bolted power connections.

.9 Inspect contactors for evidence of overheating or stress.

.10 Perform resistance measurements with a low-resistance ohmmeter for each pole of the following:

.1 Bypass contactor.

.2 Capacitor contactor, if applicable.

.3 Main disconnect/circuit breaker.

.4 Main fuses.

.11 Perform power cable insulation resistance measurements. Test voltage for 208 V or 240 V to be 500 V, 600 V rated equipment is to be 1000 V. Disconnect the power cables from the soft starter module and control power fuses prior to test. Test to include:

.1 Bypass contactor line and load to GND.

.2 Bypass contactor line to load with contactor open.

.12 Perform an operational inspection while starting, running, and stopping the motor at normal load. Include:

.1 Measurement of ramp up time.

.2 Measurement of motor current.

.3 Recording of soft starter, ammeter, and remote displayed current readings.

.4 Measurement of ramp down time.

3.19 Variable Frequency Drive, Low Voltage (less than 37.5 kW)

.1 Inspection and testing shall be comprised of the following:

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, and grounding.

.3 Clean the unit.

.4 Check the air filters.

.5 Ensure vent path openings are free from debris and that heat transfer surfaces are not contaminated by oil, dust, or dirt.

.6 Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.

.7 Visually inspect VFD grounding to ensure continuity.

.8 Inspect condition and connections of line reactors, and load reactors / load filter if present.

.9 Inspect DC bus capacitors for bulging and leakage.

.10 Cooling fans and heat sinks:

.1 Visually inspect and listen for any abnormal noises or vibration.

.2 Verify that fans rotate freely.

.3 Verify correct direction of airflow.

.4 Clean and verify integrity of heat sinks.

.5 Verify the operation of the grounding switch, if present.

.11 Perform all other work in accordance with the Manufacturer's instructions.

.2 Record the following VFD Parameters:

.1 Motor voltage, current, frequency, nominal speed, nominal power.

.2 Control mode / method.

.3 Minimum and maximum control frequency.

.4 Acceleration and deceleration time.

.5 Compare drive overcurrent set points with motor full-load current rating to verify correct settings.

.3 Power fuses:

.1 Record fuse data. Confirm that the fuses are of the correct type and rating. Utilize Manufacturer's published data where available.

.2 Measure fuse resistance.

.4 Bolted connections:

.1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50% of the lowest value.

.2 Torque all bolted connections.

.5 Inverter / Supply Module Power Connections:

.1 Remove each power module and visually inspect the contacts.

.2 Torque all cable connections.

.3 Clean all contact surfaces and apply suitable joint compound as recommended by Manufacturer.

.6 Operator Interface:

.1 Check the display and keypad for proper operation and communication.

.2 Retrieve fault history log and note any faults.

.7 Grounding/Bonding measurements:

.1 Measure the resistance of the ground bonding connection between the VFD and the main grounding bus in the corresponding electrical room.

.8 Control Wiring:

.1 Check for tightness of all accessible control wiring and torque any loose connections.

.9 Perform operational tests by initiating control devices.

.1 Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.

.2 Verify operation of drive from local start/stop and speed control signals.

.3 Verify operation of all local pilot lights.

.4 Verify the operation of any emergency stop switches.

.5 Perform all other tests in accordance with the Manufacturer's instructions.

.6 Perform all tests in accordance with the Manufacturer's recommendations and instructions.

.10 Voltage and Current Testing:

.1 With the VFD under load, measure and record the following:

.1 Incoming AC voltage and currents.

.11 With the VFD output in START/RUN mode, and at zero speed:

.1 Measure and record the AC output voltage. Voltages above 40 VAC should be investigated.

3.20 Surge Arrestors, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, grounding, and required clearances.

.3 Clean the unit.

.4 Verify that arrestors are electrically connected in their specified configuration.

.5 Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50% of the lowest value.

.6 Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

.7 Verify that stroke counter, if present, is correctly mounted and electrically connected.

.8 Perform insulation-resistance tests for one minute from each phase terminal to the case.

.9 Equipment rated greater than or equal to 600 V, utilize a test voltage of 1000 VDC.

.10 Equipment rated less than 600 V, utilize a test voltage of 500 VDC.

.11 Test the grounding connection. Resistance between the arrester ground terminal and the ground system should be less than 0.5 ohm.

3.21 Transformers, Dry-Type, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Clean the unit.

.5 Torque all accessible bolted power connections.

.6 Record the tap setting.

.7 Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Duration of the test is to be one minute. Calculate the dielectric absorption ratio.

.1 600 V windings shall be tested at 1000 VDC.

.2 120/208 V windings shall be tested at 500 VDC.

3.22 Liquid Filled Transformers

.1 Inspection and testing shall be comprised of the following:

.1 Physical and insulator damage.

.2 Conduct external inspections in accordance with layout Shop Drawings. Check nameplates and vector diagrams against test results.

.3 Inspect silica gel breathers, oil gauge, temperature gauge and similar devices where fitted. For devices with settings, record the settings in use. Record actual reading of all gauges and ambient temperature.

.4 Proper winding connections.

.5 Bolt torque level in accordance Manufacturer's recommendations.

.6 Defective wiring.

.7 Proper operation of fans, indicators, and auxiliary devices.

.8 Effective core and equipment grounding. Review neutral grounding device wiring and connections (if present).

.9 Removal of shipping brackets, fixtures, or bracing.

.10 Inspect for oil leaks, correct oil level, and sign of rusting.

.11 Integrity and contamination of bus insulation system.

.12 Verify that tap-changer is set at correct ratio for rated voltage under normal operating conditions.

.13 Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

.14 Exercise the manual tap changer to check its functions and ease of access.

.15 Operate and simulate alarm and trip conditions of each protective device.

.2 Electrical Tests:

.1 As a minimum, perform the following transformer tests:

.1 Perform high voltage AC insulation tests on high voltage windings to ground, low voltage windings to ground, high voltage windings to low voltage windings. Perform dobble test on transformer, approved equal in accordance with B8 Capacitance and Dissipation Factor tests.

.2 Inspect bushings, and measure insulation resistance with use of high voltage AC insulation test.

.3 Winding resistance measurement on all windings (standard test protocol).

.4 Oil analysis and gas analysis.

.5 H.V. test on oil samples from transformer tank for each transformer.

.6 Voltage ratio three phase, for each tap (Transformer Tap ratio).

.7 Relay and protective devices operation.

.2 Insulation Resistance Tests:

.1 Applied megohmmeter DC voltage for each:

.2 Winding-to-winding.

.3 Winding-to-ground.

.4 10-minute test duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes. Results temperature corrected in accordance with NETA ATS-2009, Table 100.14 or Table 260805-1.

.5 Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by Manufacturer.

.6 Insulation resistance test results to compare within 1% of adjacent windings.

.3 Perform tests and adjustments for fans, controls, and alarm functions as suggested by Manufacturer.

3.23 Grounding Systems

.1 Visual and Mechanical Inspection:

.1 Equipment and circuit grounds in motor control center, panelboard, switchboard, and switchgear assemblies for proper connection and tightness.

.2 Ground bus connections in motor control center, panelboard, switchboard, and switchgear assemblies for proper termination and tightness.

.3 Effective transformer core and equipment grounding and bonding.

.4 Accessible connections to grounding electrodes for proper fit and tightness.

.5 Accessible exothermic-weld grounding connections to verify that moulds were fully filled and proper bonding was obtained.

.2 Electrical Tests:

.1 Fall-Of-Potential Test:

.1 In accordance with IEEE 81, Section 8.2.1.5, perform measurements of the ground system resistance, at each Facility, and at the substation.

.2 The ground system resistance shall not exceed 0.5 ohms in summer soil conditions.

.3 Test point shall be at the North-West corner of the substation, plus at each of the individual buildings.

.4 Perform resistance testing of the connections between each ground rod and ground cabling, to ensure proper connection.

3.24 Ground Fault Systems

.1 Inspection and Testing Limited To:

.1 Zero sequence grounding systems.

.2 Residual ground fault systems.

.2 Visual and Manual Inspection:

.1 Neutral Main Bonding Connection to Assure:

.1 Zero sequence sensing system is grounded ahead of neutral disconnect link.

.2 Ground strap sensing system is grounded through sensing device.

.3 Neutral ground conductor is solidly grounded.

.2 Verify that control power has adequate capacity for system.

.3 Manually Operate Monitor Panels For:

.1 Trip test.

.2 No trip test.

.3 Nonautomatic rest.

.4 Zero sequence system for symmetrical alignment of core balance transformers about current carrying conductors.

.5 Relay check for pickup and time under simulated ground fault conditions.

.6 Verify nameplate identification by device operation.

3.25 Thermographic Inspection

.1 Camera:

.1 Minimum IR resolution: 320 x 240 pixels.

.2 Minimum visible resolution: 640 x 480 pixels.

.2 Thermographic inspections and photographs shall be completed in accordance with the recommendations of the Standard for Infrared Inspection of Electrical Systems and Rotating Equipment published by the Infraspection Institute.

.3 Provide a thermographic survey of connections associated with incoming service conductors, bus work, and branch feeder conductors and larger at each:

.1 Medium voltage switchgear.

.2 Low voltage switchgear, greater than 225A.

.3 Panelboards greater than 225A.

.4 Motor control centers.

.5 Transfer switches.

.6 All other equipment specified herein which requires a thermographic survey.

.4 Provide a thermographic survey of feeder conductors terminating at:

.1 Motors rated 50 HP and larger.

.2 Transfer switches.

.3 Engine-generators.

.5 Inspection and testing shall be comprised of the following:

.1 Remove all necessary covers prior to thermographic inspection.

.2 Equipment to be inspected shall include all current-carrying devices.

.3 Test Parameters:

.1 Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.

.2 Equipment shall detect emitted radiation and convert detected radiation to a visual signal.

.3 Thermographic surveys should be performed during periods of maximum possible loading but not less than 40% of rated load of the electrical equipment being inspected. Coordinate with City as required.

.4 Note all temperature differences larger than 1°C. Investigate all temperature differences larger than 4°C.

.5 Re-inspect deficient areas with the thermographic camera following repairs and corrections, for deficient areas identified.

.6 Provide a report which shall include the following:

.1 Description of the equipment tested.

.2 Discrepancies found.

.3 Temperature difference between the area of concern and the reference area. Probable cause of temperature difference. Identify any repairs made during the thermographic inspection. If no repairs were made, provide recommended action for repair.

.7 Areas inspected. Identify inaccessible and / or unobservable areas and / or equipment.

.1 Identify load conditions at time of inspection.

.2 Provide photographs and thermograms of all areas investigated, with deficient areas identified. Visible light photographs and thermograms shall align in a manner to allow for easy identification of the components shown on the thermograms.

.3 Provide thermograms of all deficient areas corrected and identify the load conditions at the time of re-inspection.

END OF SECTION

WIRING DEVICES

1. GENERAL

1.1 Section Includes

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 References

.1 National Electrical Manufacturers Association (NEMA):

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6:1993 (R2011), Industrial Control and Systems: Enclosures.

.2 Canadian Standards Association (CSA):

.1 C22.2 NO. 42-10 (R2015) - General use receptacles, attachment plugs, and similar wiring devices.

.2 C22.2 NO. 42.1-13 - Cover plates for flush-mounted wiring devices (Bi-national standard, with UL 514D).

.3 C22.2 NO. 55-15 - Special use switches.

.4 C22.2 NO. 111-10 (R2015) - General-use snap switches (Bi-national standard, with UL 20).

1.3 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results - Electrical.

1.4 Submittals

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

2. PRODUCTS

2.1 Manufacturer

.1 Acceptable Manufacturers:

.1 Crouse-Hinds (Eaton).

.2 Hubbell Inc.

2.2 Switches

.1 Switches to be of one manufacturer throughout project.

.2 Manually - operated general purpose AC switches shall have the following features:

.1 Terminal holes approved for AWG # 10 wire.

.2 Silver alloy contacts.

.3 Urea or melamine molding for parts subject to carbon tracking.

.4 Suitable for back and/or side wiring.

.3 Toggle-operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Surface or flush mounted.

2.3 Receptacles

.1 Receptacles to be of one manufacturer throughout project.

.2 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:

.1 Ivory urea molded housing.

.2 Suitable for # 10 AWG for back and side wiring.

.3 Eight (8) back wired entrances, four (4) side wiring screws.

.4 Break-off links for use as split receptacles.

.5 Triple wipe contacts and riveted grounding contacts.

.3 Duplex 15 A, 120 V, 3 wire, U-ground ground fault receptacle.

.4 Other receptacles with ampacity and voltage as indicated.

.5 Receptacles located in the wet areas and on the exterior of the building to be weatherproof construction.

.6 Surface or flush mounted.

2.4 Receptacle, Ground Fault Circuit Interrupter (GFCI)

.1 CSA rated.

.2 Heavy duty, tamper resistant, complete with self test with red LED indicator.

.3 Duplex, listed Class A to UL Standard 943, tripping at 5 mA.

.4 Color: white.

.5 Rating: 125 volts, configuration 5-15R, 15 amps.

.6 Standard model: screw terminals and provisions for testing.

.7 Impact resistant nylon face.

.8 Surface or flush mounted.

2.5 Cover Plates

.1 Cover plates to be of one manufacturer throughout project.

.2 Use sheet steel utility box cover for wiring devices installed in surface mounted utility boxes.

.3 Use stainless steel 1 mm thick cover plates on all wiring devices mounted in flush-mounted outlet boxes unless otherwise specified.

.4 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for single receptacles or switches.

.5 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

.6 Sheet metal cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.7 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3. EXECUTION

3.1 Installation

.1 Wherever possible, mount equipment in a straight line at a uniform mounting height, coordinated with other equipment and materials.

.2 Mount wiring devices at height in accordance with Section 26 05 00 – Common Work Results for Electrical. Mounting dimensions are to the centre of the devices. Final instructions on mounting heights shall be given by Contract Administrator at the Site. The above shall be used as a guide but shall be subject to final verification prior to installation.

.3 Switches.

.1 Install single throw switches with handle in the "UP" position when switch closed.

.2 Install switches vertically in gang type outlet box when more than one switch is required in one location.

.3 Mount switches on the latch side of the doorway as close as possible to door frame unless otherwise indicated on Drawings.

.4 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical.

.4 Receptacles:

.1 Install receptacles in a gang type outlet box when more than one receptacle is required in one location.

.2 Where split receptacle has one portion switched, mount vertically, and switch upper portion.

.3 Mount lighting fixture receptacles local to fixtures.

.4 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical.

.5 Cover Plates:

.1 Protect cover plate finish with paper or plastic film until all painting and other Work is finished, and then remove protective covering.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not distort plates by tightening screws excessively.

.4 Do not use cover plates meant for flush outlet boxes on surface mounted boxes.

END OF SECTION

DISCONNECT SWITCHES FUSED AND NON-FUSED UP TO 600 V PRIMARY

1. GENERAL

1.1 Section Includes

.1 Provide disconnect switches for 600 V and 120/240 V distribution as indicated on the Drawings.

1.2 References

.1 National Electrical Manufacturers Association (NEMA):

.1 NEMA 250 - 2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6: 1993 (R2011), Industrial Control and Systems: Enclosures.

.2 Canadian Standards Association:

.1 CAN/CSA C22.2 No.4-M89, Enclosed Switches.

.2 CSA 22.2 No.39-M89, Fuseholder Assemblies.

1.3 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results for Electrical.

1.4 Submittals

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

2. PRODUCTS

2.1 Disconnect Switches

.1 Ratings: Ampere ratings as shown on the Drawings or to suit load requirements. For motors, use disconnects switches with HP ratings at least equal to motor HP.

.2 Provide ON-OFF switch position indication on switch enclosure cover.

.3 NEMA Type 4X.

.4 Switch mechanisms: quick-make and quick-break action with self-wiping contacts, solderless pressure lug connectors.

.1 For switches 100 A and over, provide non-tracking arc shrouds.

.2 All switch poles to operate together from a common operating bar.

.5 Provide for padlocking disconnect switches in OFF position by three (3) locks. Doors to be interlocked and complete with defeat mechanism, to prevent opening when handle in ON position.

.6 Where required (namely for VFDs) provide an auxiliary contact on the disconnect such that the contact breaks prior to main contacts. Interlock auxiliary contact with emergency stop of associated motor.

.7 Neutral Bars: where distribution system has grounded neutral conductor, provide neutral bar where required with ampere rating equal to switch rating, in enclosure. Provide ground bar for terminating ground conductors.

.8 Fuse Holders: to CSA C22.2 No. 39 relocatable and suitable without adaptors, for type and size of fuse indicated.

.9 Approved Manufacturers:

.1 Eaton.

.2 Schneider Electric.

.3 Siemens.

2.2 Fuses

.1 Size as indicated.

.2 Fuses feeding motors to be of the time delay type.

.3 Provide one (1) full set of spare fuses, three (3) for each different ampere rating used, stored in suitable enclosure.

2.3 Equipment Identification

.1 Identification: provide lamacoid plate in accordance with Section 26 05 00 on each switch showing voltage, source of supply and load being fed, for example:

DS-U6001 EF-U6001 EXAUST FAN

.2 Indicate name of load controlled on size 8 nameplate.

3. EXECUTION

3.1 Installation

.1 Install disconnect switches complete with fuses if applicable.

.2 Mounting: provide supports independent of conduits. Wall-mount where possible, otherwise provided Unistrut frame support. Where switches are grouped mount in uniform arrangement.

.3 Wiring: connect line and load cable to all switches.

.4 Fuse Rating: install so that rating is visible.

END OF SECTION

CONTROL DEVICES

1. GENERAL

1.1 Section Includes

.1 Materials and installation for industrial control devices including pushbutton stations, control and relay panels.

1.2 References

.1 National Electrical Manufacturers Association (NEMA):

.1 NEMA 250 - 2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6: 1993 (R2011), Industrial Control and Systems: Enclosures.

.3 NEMA ICS 1-2000 (R2015), Industrial Control and Systems: General Requirements.

.2 Canadian Standards Association (CSA):

.1 C22.2 NO. 14-18 - Industrial Control Equipment.

1.3 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results - Electrical.

1.4 Submittals

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

.2 Include schematic, wiring, interconnection diagrams.

2. PRODUCTS

2.1 Enclosure

.1 NEMA 1 electrical rooms, area control rooms, offices.

.2 NEMA 3R (minimum) in outdoor areas.

.3 NEMA 4X in process areas.

2.2 AC Control Relays

.1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.

.2 Convertible contact type: contacts field convertible from NO to NC, electrically held permanent magnet latched or double-voltage type with sliding barrier to permit access to contacts only or coil only as indicated, solid state timer and poles overlap type.

2.3 Relay Accessories

.1 Standard contact cartridges: normally open - convertible to normally closed in field.

2.4 Pushbuttons

.1 Heavy duty oil tight. Operator extended or mushroom type. Black and Green, with 1-NO and 1-NC contacts rated as required, labels as indicated.

.2 Stop pushbuttons coloured red, provision for padlocking in depressed position, labelled "Emergency Stop" on lamacoid with large white letters on red background.

2.5 Selector Switches

.1 Maintained, 2 or 3 position labelled as indicated heavy-duty oil tight, operator's wing lever, contact arrangement as indicated, rated as required.

2.6 Indicating Lights

.1 Heavy-duty oil tight, transformer light emitting diode (LED) type, push-to-test, lens colour: as indicated, supply voltage: as required, lamp voltage: as required, labels as indicated.

2.7 Control and Relay Panels

.1 CSA Type 1 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.8 Thermostat (Line Voltage)

.1 Wall mounted, for exhaust fan control.

.2 Full load rating: 8 A at 120 V.

.3 Markings in 5-degree increments.

2.9 Manual Switches

.1 Wall mounted.

.2 Suitable up to 30A.

.3 Single phase disconnect.

.4 NEMA Type 4.

.5 Wall mounted.

.6 Schneider 2510K or approved equal.

2.10 Single Phase Small Motor Starter

.1 1HP or less.

.2 277VAC or less.

.3 Toggle operated.

.4 Red indicator light.

.5 Wall mounted.

.6 Non reversing starter.

.7 Singe phase.

.8 NEMA type 4.

.9 Schneider 2510FW1P or approved equal.

3. EXECUTION

3.1 Installation

.1 Install pushbutton stations, control and relay panels, control devices and interconnect.

3.2 Field Quality Control

.1 Perform testing in accordance with Section 26 05 00 Common Work Results - Electrical.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

.5 Submit to Contract Administrator one (1) copy of test results.

END OF SECTION

LIGHTING

1. GENERAL

1.1 Codes and Standards

.1 Canadian Standards Association.

.2 Underwriters Laboratories of Canada (ULC).

.3 IES LM79 & LM80.

1.2 Submittals

.1 Provide submittals in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit Manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, and limitations.

.3 Include equipment catalog numbers and fixture type on all submitted Shop Drawings.

1.3 Quality Assurance

.1 All equipment and materials are to be new and CSA approved.

2. PRODUCTS

2.1 General

.1 Luminaires to be CSA approved.

.2 Provide supporting devices, plaster frames, junction boxes and outlet boxes where required.

.3 Where soffits or ceilings have thermal insulation, provide fixtures which are CSA approved for such use.

.4 Luminaire types shall be as indicated on the Drawings. In general, the Facility shall have several different luminaire types, which include fluorescent as well as LED. A request for equal from a different luminaire Manufacturer/vendor shall be submitted and approved (if deemed to be equal by the Contract Administrator) in accordance with the Contract Documents prior to tender close.

.5 Refer to the Drawings for the fixture types, manufacturer, and model numbers.

2.2 Fluorescent Lamps

.1 Provide lamps for all fixtures as applicable.

.2 Fluorescent lamps shall suit the luminaire.

.3 Burn in fluorescent lamps for a minimum of 100 hours prior to switching in order to burn off all impurities.

2.3 Fluorescent Ballasts and Accessories

.1 Provide ballasts and accessories to suit the fixture type. Ballasts shall be Manitoba Hydro power smart approved.

.2 Provide ballasts with non-PCB type capacitors with pressure sensitive devices to prevent rupturing.

.3 Provide discreet electronic rapid start 120 V fluorescent ballasts, automatic reset thermal protected, 90% power factor, group A noise rating. Only Premium High Efficiency approved ballasts will be accepted.

2.4 LED Lighting

.1 Refer to luminaire schedule on the Drawings for acceptable products.

.2 General Requirements:

.1 Voltage Rating: As indicated on Drawing.

.2 Power rating: As indicated on Drawings.

.3 Input Frequency: 60 Hz.

.4 Correlated Color Temperature (CCT): minimum 4000K.

.3 Indoor lighting:

.1 L70 at 60 000 hours or greater.

.2 Color Rendering Index (CRI): >= 80.

.3 NEMA 4X or approved equal in accordance with B7.

.4 Aluminum or stainless steel housing.

2.5 Finish

.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

3. EXECUTION

3.1 Manufacturer’s Instruction

.1 Comply with the Manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Installation

.1 General:

.1 The Contractor is responsible for upsizing conductors to account for voltage drop. Conductor sizes as described on the Drawings, cable schedules and elsewhere are minimum size, and are highly dependent on specific cable routing. The Contractor shall upsize wiring as required to meet the requirements herein, and to comply with CEC requirements.

.2 Calculate voltage drop based on 80% of the breaker rating.

.2 Locate and install luminaires as indicated on Drawings.

.3 Luminaires shall be installed in accordance with the Manufacturer's recommendations and the requirements herein. Each luminaire shall be solidly and rigidly installed so that the fixture does not move or swing. Acceptable means of support include:

.1 Rigid Aluminium Conduit/Pipe.

.2 Threaded Rod.

.3 Cantruss.

.4 Wire and connect fixtures using 12 AWG or larger, RW90 run in conduit. Conduit to be as specified in Section 26 05 34, Conduits, Conduit Fasteners and Conduit Fittings.

.5 Short flexible connections less than 2 meters in length to luminaires may be HL rated TECK90 cable.

.6 Drawings do not show conduit routing or conduit sizes and wire counts. Supply and install a complete system of conduit and wire for the lighting system. Make all connections and install all conductors for the switching and branch circuiting indicated and required.

.7 Conduits shall be sized in accordance with CEC requirements for wire counts installed. Conduit size shall be 21 mm or greater. Conductors shall be de-rated according to code requirements. Upsize conductors as required to meet CEC and voltage drop requirements.

.8 Install a permanent label or lamacoid for all luminaires indicating the circuit(s) connected.

3.3 Luminaire Supports

.1 Provide adequate support to suit ceiling or wall mounted luminaires.

3.4 Control

.1 As indicated on Drawings.

3.5 Field Quality Control

.1 Operate each fixture after installation and connection. Each fixture shall be inspected for proper connection and operations.

.2 Perform testing of all lighting systems.

.3 Completely clean the exterior, interior, lamps, lenses, etc. of all luminaires after construction and prior to turning over to the City.

3.6 Protection

.1 Lighting fixtures, once installed, shall be protected from damage during the remainder of the construction period. Make good and replace any damages occurring during construction.

.2 Damage to luminaires occurring during construction shall be replaced by the Contractor at the Contractor's expense. The decision as to what constitutes a damaged fixture which requires replacement is at the discretion of the Contract Administrator.

END OF SECTION

EMERGENCY LIGHTING

1. GENERAL

1.1 Section Includes

.1 Materials and installation for emergency lighting systems.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 141-10, Emergency Lighting Equipment.

.2 CSA 22.2 No. 107-3, Uninterruptible Power Systems.

.3 Latest approved edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 UL 942, Standard Emergency Lighting and Power Equipment.

.3 SOR/86-304, Canadian Occupational Health and Safety Regulations.

.4 Illuminating Engineering Society of North America (IESNA).

1.3 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results for Electrical.

.3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.4 Section 26 52 13.16 – Exit Signs.

1.4 Submittals

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 26 05 00 – Common Work Results for Electrical.

.2 Product Data:

.1 Submit Manufacturer’s printed product literature, Specifications and datasheets and include product characteristics, performance criteria, and limitations.

.3 Submit Shop Drawings to include:

.1 System configuration with single-line diagrams.

.2 Wiring diagrams, indicating terminal numbers.

.3 Over-current protection decides, indicating recommended breaker sizes.

.4 A complete set of equipment drawings.

.5 Equipment Specifications, including weights, dimensions, and head dissipation.

.6 Capacity data.

.7 Descriptions of equipment to be furnished.

.8 Size and weight of shipping units to be handled by installing contractor.

.9 Bill of materials and recommended spare parts list.

.10 Detailed installation procedures.

.11 Instruction manuals. Manuals shall include a functional description of the equipment, installation instruction, safety precautions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

.12 Manufacturer recommended Field Commissioning and Test Procedures.

1.5 Closeout Submittals

.1 Provide data for incorporation into operation and maintenance manual. Operations and Maintenance manual to include:

.1 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operations maintenance and repair.

.2 Testing and Commissioning report, both factory test and site testing reports.

1.6 Quality Assurance

.1 Before shipment, the Manufacturer shall fully and completely test the system to assure compliance with the Specification.

1.7 Warranty

.1 For batteries, the twelve (12) months warranty period prescribed in subsection GC32.1 of General Conditions "C" is extended to 120 months, with no-charge replacement during the first five (5) years and pro-rate charge on the second five (5) years.

2. PRODUCTS

2.1 Equipment

.1 Emergency lighting equipment: to CSA C22.2 No.141.

.1 Supply voltage: 120 VAC.

.2 Operating time: 30 min.

.2 All emergency lighting to be LED.

.3 All emergency lighting to be rated for the environment in which it is installed.

.4 A 24 VDC battery bank with two LED lighting heads to be provided as required for each area. Battery banks shall be sized to power connected loads as per the Building Code.

.1 Battery: sealed, maintenance free.

.2 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations.

.3 Solid state transfer circuit.

.4 Low voltage disconnect solid state, modular, operates at 80% battery output voltage.

.5 Lamp heads: integral on unit and 180 degrees vertical adjustment.

.6 Suitable for wall, end or ceiling mounting and complete with knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.7 Finish: factory white.

.5 Auxiliary equipment:

.1 Test switch.

.2 Battery disconnect device.

.3 AC input and DC output terminal blocks inside cabinet.

.4 Cord and single twist-lock plug connection for AC.

2.2 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.3 Wiring

.1 Provide all AC/DC wiring for emergency lighting as per current edition of Manitoba Building Code.

.2 Conduit: Rigid Aluminum or PVC, in accordance with Section 26 05 34 - Conduits, Conduit Fasteners and Conduit Fittings, and Table 4-4 of the City of Winnipeg Electrical Design Guide.

.3 Conductors: type in accordance with Section 26 05 21 - Wires and Cables 0-1000 V, sized as indicated in accordance with manufacturer's recommendations.

3. EXECUTION

3.1 Manufacturer's Instruction

.1 Compliance: comply with Manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 General

.1 Emergency lighting will be located in compliance with the Code.

.2 Illumination levels will generally follow IESNA guidelines, Manitoba Building Code, and Canadian Occupational Health and Safety (SOR/86-304). Where these regulations and guidelines conflict, comply with the most stringent condition.

3.3 Installation

.1 Install unit equipment and remote mounted fixtures.

.2 Direct heads.

END OF SECTION

EXIT SIGNS

1. GENERAL

1.1 References

.1 SOR/86-304, Canadian Occupational Health and Safety Regulations.

.2 Illuminating Engineering Society of North America (IESNA).

.3 Canadian Standards Association (CSA):

.1 Latest approved edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.2 Submittals

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 26 05 00 – Common Work Results - Electrical.

1.3 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results - Electrical.

.3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.4 Section 26 52 13.13 - Emergency Lighting.

2. PRODUCTS

2.1 Equipment

.1 Exit signs to be of the green pictogram style (“running man”).

.2 Exit signs and to be rated for the environment in which they are installed.

.1 Exit signs installed in process areas to be NEMA 4X.

.3 Provide all AC/DC wiring for exit signs as per current edition of Manitoba Building Code.

.4 Non-Hazardous Industrial Locations.

.1 NEMA-4X rated.

.2 White light-emitting diode (LED).

.3 Voltage input: 120 VAC.

.4 Less than 2.5 W.

.5 Equipment frame: Industrial grade polyvinyl chloride.

.6 Faceplate: Sealed heavy duty, vandal-resistant polycarbonate.

.7 Single or double face option. Shall include straight, right, and left faceplates.

3. EXECUTION

3.1 General

.1 Exit signs will be located in compliance with the Code.

.2 Illumination levels will generally follow IESNA guidelines, Manitoba Building Code, and Canadian Occupational Health and Safety (SOR/86-304). Where these regulations and guidelines conflict, comply with the most stringent condition.

3.2 Installation

.1 Install exit signs to Manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.

.2 Install exit signs at locations with direct arrows to suit the location, with single or double face as noted on Drawings. Provide all mounting devices, orientation, supports and installation.

.3 Exit signs indicated on the Drawings are shown at their approximate location. The Contractor is to provide mounting supports and is to adjust the exact location and mounting elevation in order to provide a clear field of view to the exit sign. Exit signs which are blocked by equipment or blocked due to location will not be accepted and shall be relocated at no additional cost in order to be clearly visible.

.4 Connect fixtures to exit light circuits using 12 AWG or larger ,RW90 wire. Wire and connect exit signs using conduit as specified in Section 26 05 34 - Conduits, Conduit Fasteners, and Conduit Fittings.

.5 The Contractor is to ensure that the exit signs are located in a manner such that they are visible throughout the required floor area. Coordinate location with other trades. Make location adjustments to suit at no additional cost.

.6 Provide tests in accordance with Section 26 08 05 - Acceptance Testing.

END OF SECTION

FIRE DETECTION AND ALARM

1. GENERAL

1.1 Codes and Standards

.1 Government of Canada:

.1 NBC (Latest), National Building Code of Canada.

.2 ISO 8201, Acoustics – Audible emergency Evaluation Signal.

.3 Underwriter's Laboratories of Canada (ULC):

.1 CAN/ULC-S524, Installation of Fire Alarm Systems.

.2 ULC-S525, Audible Signal Appliances for Fire Alarm.

.3 CAN/ULC-S526, Visual Signal Appliances, Fire Alarm.

.4 CAN/ULC-S527, Control Units.

.5 CAN/ULC-S528, Manual Pull Stations.

.6 CAN/ULC-S529, Smoke Detectors.

.7 CAN/ULC-S530, Heat Actuated Fire Detectors.

.8 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.

.9 CAN/ULC-S537, Verification of Fire Alarm Systems.

.4 NFPA 720 – Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment.

.5 NFPA 13 – Standard for the Installation of Sprinkler Systems.

.6 CSA C22.1 Canadian Electrical Code.

.7 Manitoba Building Code.

.8 Winnipeg Electrical Code.

1.2 Description

.1 Provide fire detection and alarm as indicated and in compliance with Contract Documents.

.2 The System shall include, but not be limited to: Verifying the existing fire alarm initiating and notification devices and tie new devices into the existing system.

.3 The fire alarm system shall include conduit, wire, fittings, and accessories required to provide a complete operating system.

.4 All charges and fees required by the local Authority having jurisdiction (AHJ) to inspect the installation and implement fire alarm notification are to be included by the Contractor under this section at no additional cost to the City.

.5 System shall include a voice evacuation panel in compliance with NFPA 720 requirements.

1.3 System Description

.1 Type of System:

.1 Fire Alarm System: The fire alarm system shall operate as a low voltage type system and shall automatically initiate fire alarm signals whenever any manual or automatic fire detecting devices are placed into an alarm mode. The system shall indicate areas of alarm and sound local alarms.

.2 The system shall be capable of operating with a single break or ground fault condition in the initiating or alarm sounding circuits.

.3 Evacuation Alarms: Coded evacuation alarm: A fire alarm signal shall be employed for notifying the occupants to evacuate.

.4 Evacuation Alarms: Speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor. Loss of any speaker circuit shall not cause the loss of any other speaker circuit.

.5 Trouble Signals: During abnormal conditions such as an open wire or a ground fault, or where both conditions occur at one point, the system shall be capable of automatically transmitting clear, intelligible trouble signals.

.6 The system shall interface to HVAC system and other building systems required by applicable codes to provide all required monitoring and control functions.

1.4 Submittals

.1 Submit the following Shop Drawings in accordance with Section 01 33 00.

.1 Copy of this Specification Section with addenda and all referenced Specification Sections with addenda check-mark each paragraph to indicate specification compliance or indicate deviation and reason for deviation.

.1 Failure to include a copy of the marked-up Specification Sections will result in return of the entire submittal with no further review and consideration.

.2 Installer and system supplier qualifications and list of three (3) similar projects with name and phone number of contact person.

.3 Complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts. Shop Drawings shall contain complete conduit riser diagrams, wiring diagrams, and schematic diagrams for the equipment furnished. Riser diagrams shall identify cable sizes and quantities, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

.4 Manufacturer's printed installation instructions.

.5 Field verify and provide schematic and riser of existing circuit.

.6 Wiring diagrams from the fire alarm system integrator or supplier differentiating clearly between factory and field installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Identify all diagrams to be specific to this project and distinguish between field and factory wiring.

.2 Operating and Maintenance Instruction Manuals:

.1 At end of project, submit operating instruction manuals as specified in Section 01 78 23, outlining the step-by-step procedures required for system startup and operation shall be furnished. The instructions shall include the manufacturer's name, model number, service manual parts list and brief description of all equipment and their basic operating features.

.2 Maintenance instructions manuals outlining maintenance procedures shall be furnished. The manual shall include a troubleshooting guide listing possible breakdown and repairs and a simplified connection wiring diagram for the system as installed. Provide the names, addresses, and telephone numbers of service organizations that provide technical assistance and carry stock of repair parts for the system to be furnished.

.3 Performance Test Reports: Upon completion of the installed system, submit in booklet form field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

.3 Submit Certificate of Compliance, signed by manufacturers of fire alarm system components certifying that their products comply with specified requirements.

.4 Submission to Authorities Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authorities having jurisdiction. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review. Upon receipt of comments from the authorities having jurisdiction, submit them for review. Resubmit if required to make clarifications or revisions to obtain approval.

1.5 Quality Assurance

.1 Qualifications:

.1 Technician with minimum of Engineering Technologist Certification for fire alarm systems or Professional Engineer registered in Province of Manitoba shall be available on-site.

.1 Service technician shall be formally trained by the fire alarm Manufacturer.

1.6 Delivery, Storage and Handling

.1 Comply with the requirements specified in Section 01 60 10.

.2 Equipment placed into storage shall be protected from the weather, humidity and temperature variations, dirt, dust, and other contaminants.

2. PRODUCTS

2.1 Manufacturers

.1 Notifier.

.2 Or approved equal.

2.2 Material and Equipment

.1 General Product Description:

.1 Each Fire-Alarm Control Panel (FACP) shall be capable of fire detection, equipment supervision and control, alarm management, and historical data collection and archiving.

.2 System Features

.1 Alarm Messages: In addition to the point's description and the time and date, the user shall be able to print, display or store a custom alarm message to more fully describe the alarm condition or direct operator response.

.2 Each detector shall be provided with a steel mounting plate, and the entire unit shall mount on a double gang electrical box.

.3 Provide devices suitable for the area classifications as indicated on the Contract Drawings (i.e., NEMA 1, NEMA 4, NEMA 4X, and NEMA 7 (Class I, Division 1 or 2) NEMA 4X, etc.).

.3 Devices:

.1 Refer to Drawings for locations and device models.

.4 Terminal Cabinets:

.1 Provide a terminal cabinet at the base of any circuit riser, and where indicated on the Drawings.

.2 Terminal size shall be appropriate for the size of the wiring to be connected.

.3 Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the terminal cabinet.

.4 Minimum size is 8 inch high by 8 inch.

.5 Alarm Wiring:

.1 Signaling line circuits and initiating device circuit field wiring shall be copper, 18 AWG size conductors at a minimum.

.2 Notification appliance circuit conductors, that contain audible alarm devices, shall be solid copper 14 AWG size conductors at a minimum.

.3 Where a voice evacuation system is specified, speaker circuits shall be copper 16 AWG size conductors at a minimum.

.4 Wire size shall be sufficient to prevent voltage drop problems.

.5 Power wiring, operating shall be 12 AWG solid copper having similar insulation.

.6 Provide all wiring in rigid metal conduit.

.6 Conductor Terminations:

.1 Labeling of conductors at terminal blocks in terminal cabinets, FACP, and remote fire alarm control units shall be provided at each conductor connection.

.2 Each conductor or cable shall have a shrink-wrap label to provide a unique and specific designation.

.3 Each terminal cabinet, FACP, and fire alarm control unit shall contain a laminated drawing which indicates each conductor, its label, circuit, and terminal.

.4 The laminated drawing shall be neat, using 12 point lettering minimum size, and mounted within each cabinet, panel, or unit so that it does not interfere with the wiring or terminals.

.5 Maintain existing color code scheme where connecting to existing equipment.

3. EXECUTION

3.1 Installation

.1 Install systems in accordance with CAN/ULC S524, Manufacturer's instructions and recommendations, and in accordance with applicable codes and standards.

.1 Wiring: Wiring for systems shall be installed in conduit. Ruse existing fire alarm conduit system where applicable; otherwise, provide conduit as specified in Section 26 05 32.

.2 Conduit fill not to exceed 40%.

.3 Detectors: Detectors shall be installed in accordance with manufacturer's printed instructions.

.4 Connect alarm circuits to FACP.

.5 Install end of line devices as required at end of conventional NACs and IDCs.

.1 End-of-line devices to be in a separate enclosure, mounted less than 1800 mm AFF.

.6 Install pull boxes in each conduit at intervals not to exceed 30 m. Pull boxes to be 100 mm square, minimum.

.7 Provide complete wiring and conduit between all equipment. Devices shall be mounted upon CSA listed boxes. Wiring splices and transposing or changing of colors will not be permitted.

.8 Junction boxes shall be painted red and labeled as “Fire Alarm System” with decal or approved markings.

.9 Firm Alarm control systems and equipment shall be connected to separate dedicated branch circuits, sized as required for proper service. Circuits shall be labeled “FIRE ALARM.”

.10 Review the design drawings and perform a walk-through of all areas with the AHJ.

.2 Mounting Heights:

.1 Mount fire alarm equipment at heights specified or if not specified, as indicated in CAN/ULC S524.

3.2 Field Testing

.1 Perform all tests to verify the correction of defects found in the initial testing. If testing identifies system modifications are required to accomplish the required operation, perform work at no additional cost to the City and retest the system.

.2 Furnish training as follows:

.1 Training in the receipt, handling and acknowledgment of alarms.

.2 Training in the system operation including manual control of output functions from the system control panel.

.3 Training in the testing of the system.

3.3 Closeout Activities

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

PRECAST CONCRETE PILES

1. GENERAL

1.1 Related Sections

.1 Supply, pick-up, delivery and install piles.

.2 Design Requirements:

.1 Design loads as indicated on structural drawings.

.2 Do not splice piles without Contract Administrator's permission. When permitted, provide details for Contract Administrator review. Design details of splice to bear signature and stamp of Professional Engineer registered or licensed in Province of Manitoba.

1.2 Quality Assurance

.1 Precast concrete components shall be fabricated by manufacturer certified by CSA as meeting requirements of CSA A251.

.2 All Work shall be performed by a Contractor experienced in related type or work and having at his disposal all necessary equipment.

.3 Allowable tolerances:

.1 Lateral tolerances: units shall be located so as to have maximum lateral deviation at top of unit of 50 mm.

.2 Vertical tolerance: piles shall be driven without varying more than 2% from vertical.

.3 Pile cutoffs at elevations indicated ±38 mm.

.4 Piles not meeting these requirements will be rejected.

.4 Drive units to develop loads as indicated on Drawings.

.5 All Work shall comply with local and provincial safety codes and regulations.

1.3 Test Reports

.1 Upon request, submit certified copies of quality control tests related to this project as specified in CSA A251.

1.4 Site Conditions

.1 Visit site to ascertain special conditions which may affect Work.

.2 Review the Geotechnical Report to identify subsurface conditions that may be encountered.

1.5 Delivery and Storage

.1 Minimum size holes are permitted to facilitate handling and lifting to vertical position.

.2 Provide identification for points of lifting by painted stripes or lift hooks set in.

.3 Provide identification for points of support for storage. Store all units at site in such a way as to avoid undue stresses before driving.

.4 During delivery and storage support long piles continuously along their lengths.

.5 All foundation units delivered to Site, which do not conform to terms of this Specification may be rejected by Contract Administrator or his representative.

1.6 Protection

.1 Protect public and construction personnel, adjacent structures and Work of other sections from hazards attributable to pile driving operations.

.2 Protect pile surfaces from damage and spalling.

1.7 Scheduling

.1 Submit schedule of planned sequence of driving to Contract Administrator for review, not less than two (2) weeks prior to commencement of pile driving for structure.

.2 Do not commence pile driving until authorized to proceed by Contract Administrator.

2. PRODUCTS

2.1 Materials

.1 Piles: standard hexagonal, precast, prestressed, to sizes indicated on Drawings, by an approved supplier.

.2 Cement: Type HS, sulphate resistant.

.3 Concrete strength: 35 MPa at time of driving. Concrete strength at transfer of prestress shall be minimum 25 MPa.

.4 Prestressing steel: to CSA G279 steel for prestressed concrete tendons.

.5 Welded wire mesh: to CSA G30.5.

.6 Spiral reinforcement: to CSA G30.3, cold drawn steel wire.

.7 Pile connections: capable of providing positive means to hold pieces together, maintaining alignment for full depth and transmitting full design load. Submit details of connector for review by Contract Administrator.

2.2 Fabrication

.1 Fabricate precast concrete piles to lengths, cross sectional areas, reinforcement pile connectors pile rock points as indicated.

.2 Fabricate piles to following finish tolerances:

.1 Length: ±3 mm/metre of length.

.2 Cross section: solid section -6 to +12 mm.

.3 Deviation from straight line: not more than 3 mm/metre of length, 12 mm in full length.

.4 Pile head: ±10 mm/metre from true right angle plane. Surface irregularities ±3 mm.

.5 Location of reinforcing steel main reinforcing cover: -3 to +6 mm. Spacing of spiral ±12 mm.

3. EXECUTION

3.1 Installation

.1 Provide approved type of protection cap with cushion block to top of pile when driving. Cushion block material softwood such as green hemlock. Plywood not acceptable.

.2 Splice piles, if required, using approved method of splicing.

.3 On completion of driving, cut off pile at required elevation. Make circumferential cut with a concrete saw to prevent spalling of pile below cut-off elevation. Make pile cut off absolutely horizontal.

.4 Drive piles at locations indicated and to depth sufficient to develop required loading.

.5 Minimum prebored depth for piles from excavation: 6.0 m.

.6 Make prebored holes 50 mm larger in diameter than piles to be placed unless indicated otherwise on the drawings.

.7 Remove boulders or existing concrete foundations encountered in prebored holes using a core barrel or other approved method.

.8 Remove, relocate, re-drive and provide additional piles where directed when boulders or other obstructions prevent driving piles to an adequate bearing strata or within allowable tolerances in locations indicated on the drawings. Perform such work no additional cost to the Contract.

.9 Perform pile driving with a hammer capable of delivering a rated energy of at least 40,600 joules.

.10 Refusal criteria for driving piles shall be established by inspection at time of driving.

.11 Replace piles excessively damaged through driving or which are believed to be broken, with a new pile at a suitable location at no additional cost to Contract.

.12 Piles shall be of sufficient length to allow approximately 460 mm of strand to extend into structure above.

.13 If a pile or piles should be driven below required elevation to accommodate exposed strand requirements, cut off such piles 460 mm below the top of pile (except at single pile caps). Build up piles to details provided by Contract Administrator at no additional cost to the Contract.

.14 Drive piles to required final set in competent hard glacial till deposit.

.15 Drive piles continuously, without intermission until driven to required final set, at depth adequate to support the loads indicated on the Drawings.

.16 Observe and check pile upheaval. Re-drive pile to refusal and final set any piles showing uplift after driving adjacent piles.

3.2 Repair/Restoration

.1 One or more of the following remedial measures may require:

.1 Remove rejected pile and replace with a new, and if necessary, a longer pile.

.2 Remove rejected pile and fill holes as directed.

.3 Leave rejected pile in place and cut off as directed by Contract Administrator.

.4 Leave rejected pile in place, place adjacent pile(s), and modify pile cap as directed.

3.3 Field Quality Control

.1 Notify Contract Administrator or his representative sufficiently in advance of pile installation to allow necessary inspections to be carried out.

.2 An accurate driving record of penetration per blow shall be kept by the inspector or in his absence by the piling subtrade. These records shall include final penetration resistance, pile heave and amount of downward movement on redrive.

.3 Inspection of pile driving operations shall be supplied by an independent inspection and testing agency designated by Construction Manager.

3.4 Clean-Up

.1 After installation of foundation units, remove all excess concrete and other debris and leave Site in clean condition.

END OF SECTION

EARTH WORK

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for earthworks related to pavement and sidewalk construction. This includes excavation of organic and saturated materials, placement of suitable site and imported fill in pavement sub-grade and boulevard areas, backfilling of existing swale areas within the limits of the construction area and excavation required for placement of base and sub-base materials for new pavement structures.

2. PRODUCTS

2.1 Fill Material

.1 Suitable Site Material to be as per City of Winnipeg Standard Construction Specification CW 3170.

.2 Imported Fill Material to be as per City of Winnipeg Standard Construction Specification CW 3170.

3. EXECUTION

3.1 General

.1 Do not perform Work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

3.2 General and Ditch Excavation

.1 Remove all standing water from existing ditch bottoms or general areas requiring excavation.

.2 All vegetation and topsoil shall be removed from ditches or general areas. The sideslopes of existing ditches are to be cut to approximately 4H:1V or flatter to provide a transition zone between the in-situ and fill material.

.3 Prior to placement of fill material the sub-grade shall be benched in order to key in the fill material to the in-situ material. The bench dimensions shall be as determined in the field by the Contract Administrator. Benching shall be considered incidental to excavation and no further payment shall be made.

.4 The base of all areas to be filled shall be proof rolled in the presence of the Contract Administrator, prior to backfilling, to confirm that the sub-grade is undisturbed, competent, has been adequately cleaned of ponded water, disturbed, loosened, saturated, softened, organic and other deleterious material. Remedial work shall be carried out as directed by the Contract Administrator. Proof rolling shall be considered incidental to the placement of fill material in ditches and general fill areas and no additional payment shall be made.

.5 Excavation for placement of pavement base materials, outside ditch areas, to be completed in accordance with City of Winnipeg Standard Construction Specification CW 3170.

3.3 Placement of Fill Material

.1 Fill material in sub-grade, boulevard and ditch areas shall be placed in 300 mm maximum depth loose lifts at or near to optimum water content and compacted to a minimum of 95% of its Standard Proctor density to the elevation of bottom of the sub-base material for pavement areas or topsoil for boulevard areas.

3.4 Sub-grade Compaction

.1 The Contractor shall compact the sub-grade in areas of new pavement construction where excavation is required to place sub-base and base course material. Sub-grade Compaction will be completed in accordance with CW 3110.

3.5 Restoration of Access Ramp Areas

.1 Where fill is placed against existing materials, use stair-like benches with raise and step of same length to bond and key-into the existing fill. Raise and step length shall be a minimum of 0.3 m with a maximum height of step not to exceed 1 m.

.2 Works to be completed in accordance with CW 3170 Earthwork and Grading.

.3 Scarify the top 75 mm of the previous lift before placing the next layer.

.4 Rework or remove and replace defective fill placed at densities lower than the specified density or at moisture contents outside the specified acceptable range of moisture content or otherwise not conforming to the requirements of the Contract Documents.

END OF SECTION

SUB-BASE MATERIAL

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for the placement and compaction of sub-base course material for the construction of the new roadways and parking areas.

2. PRODUCTS

2.1 Sub-Base Material

.1 Sub-base Material to be as per City of Winnipeg Standard Construction Specification CW 3110 for Crushed Sub-base Material, 50 mm Granular A.

3. EXECUTION

3.1 General

.1 Do not perform Work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

.2 Placement and Compaction of Base Material:

.1 Complete placement and compaction of sub-base material in accordance with City of Winnipeg Standard Construction Specification CW 3110.

END OF SECTION

BASE MATERIAL

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for the placement and compaction of base course material for the construction of the new roadways and parking areas.

2. PRODUCTS

2.1 Base Course Material

.1 Base Course Material to be as per City of Winnipeg Standard Construction Specification CW 3110 for Granular A.

3. EXECUTION

3.1 General

.1 Do not perform Work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

3.2 Placement and Compaction of Base Material

.1 Complete placement and compaction of base material in accordance with City of Winnipeg Standard Construction Specification CW 3110.

END OF SECTION

ASPHALTIC CONCRETE PAVING

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for the placement of the asphaltic concrete for pavements and overlays for the construction of new roadways and new parking areas.

2. PRODUCTS

2.1 Asphaltic Concrete Pavement

.1 Asphaltic Concrete to be supplied as per City of Winnipeg Standard Construction Specification CW 3410, for Type 1A Asphalt.

3. EXECUTION

3.1 General

.1 Do not perform Work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

3.2 Placement of Asphaltic Concrete Pavement

.1 Complete placement of asphaltic concrete pavement and overlays in accordance with City of Winnipeg Standard Construction Specification CW 3410.

.2 The finished surface of each lift of bituminous pavement shall be smooth, free from segregation and roller marks, uniform and true to line and cross-section as shown on the Plans or as specified by the Contract Administrator.

.3 Finished top lift pavement, on which the surface is defective in texture, uniformity or riding quality, shall be correct at the expense of the Contractor if so directed by the Contract Administrator. Correction shall be as outlined in Table 1.

Table 1: Bituminous Pavement

Defect Criteria	Rejection level	Type of Repair
Bituminous Mix Properties	Outside the following Ranges VMA 14 – 16% In place air voids 3 – 5%	Remove and replace
Segregation Minor to severe	As per definition >10% 100 m of one lane pavement	Remove and replace - Final lift only
Surface Defects		
	Areas containing excess or insufficient asphalt	Remove and replace
	Improper matching of longitudinal and transverse joints on final lift of asphalt concrete	Remove and replace joint

Table 1: Bituminous Pavement

Defect Criteria	Rejection level	Type of Repair
	Roller marks on final lift of asphalt concrete	Remove and replace
	Cracking or tearing	Remove and replace
	Contamination by diesel, hydraulic fluids, detergent or other harmful product	Remove and replace
	Foreign objects or materials that are detrimental to the asphalt concrete; and Clay balls or oversized materials	Remove and replace
Density	Average of Measured densities to be >97% with no individual test being <95%	Remove and replace

END OF SECTION

PORTLAND CEMENT CONCRETE PAVING

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for the construction of the new Portland cement concrete pavement for new roadways.

2. PRODUCTS

2.1 Portland Cement Concrete

.1 Portland Cement Concrete to be as per City of Winnipeg Standard Construction Specification CW 3310.

2.2 Reinforcing Steel

.1 Reinforcing steel to be as per City of Winnipeg Standard Construction Specification CW 3310.

2.3 Drilled Dowels and Tie Bars

.1 Drilled Dowels and Tie Bars to be as per City of Winnipeg Standard Construction Specification CW 3230.

2.4 Dowell Assemblies

.1 Dowel Assemblies to be as per City of Winnipeg Standard Construction Specification CW 3310.

3. EXECUTION

3.1 General

.1 Do not perform Work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

3.2 Portland Cement Concrete Pavement

.1 Complete placement of Portland cement concrete pavement in accordance with City of Winnipeg Standard Construction Specification CW 3310.

3.3 Joint Sealing

.1 Complete sealing of all joints in Portland cement concrete pavement in accordance with City of Winnipeg Standard Construction Specification CW 3310.

END OF SECTION

CONCRETE WALKS, CURBS, AND GUTTERS

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for the construction of the new Portland cement concrete sidewalks, curb and curb and gutter for the new roadway and parking areas.

2. PRODUCTS

2.1 Portland Cement Concrete

.1 Portland Cement Concrete to be as per City of Winnipeg Standard Construction Specification CW 3310.

2.2 Reinforcing Steel

.1 Reinforcing steel to be as per City of Winnipeg Standard Construction Specification CW 3310.

2.3 Drilled Tie Bars

.1 Drilled Tie Bars to be as per City of Winnipeg Standard Construction Specification CW 3230.

3. EXECUTION

3.1 General

.1 Do not perform Work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

3.2 Construction of Concrete Sidewalk, Curb and Curb and Gutter

.1 Complete construction of concrete curb and curb and gutter in accordance with City of Winnipeg Standard Construction Specification CW 3310.

.2 Complete construction of concrete sidewalk in accordance with City of Winnipeg Standard Construction Specification CW 3325.

END OF SECTION

1. GENERAL

1.1 Description

.1 This Section provides the requirements associated with the excavation, trenching and backfilling for utilities.

1.2 References

.1 The following Specifications of the City of Winnipeg Standard Construction Specifications - latest edition are applicable to the Work:

.1 CW 2030 Excavation, Bedding and Backfill.

.2 Division 3 Standard Details – Underground Works:

.1 SD-001 Standard Pipe Bedding Classes.

.2 SD-002 Standard Trench and Excavation Backfill Classes.

.3 SD-003 Jetting Nozzle Insertion Locations.

.3 Division 3 Approved Products for Underground Works.

1.3 Underground Commissioning Reports

.1 Once any underground infrastructure (pipes, cables, ductbanks, tanks, etc.) is commissioned and prior to any backfilling, the Contractor is to provide the Contract Administrator with the underground commissioning report within five (5) days of completing the installation work prior to any backfilling.

.2 The underground commissioning report shall include at a minimum the following:

.1 Photographs of all locations of the installed infrastructure and include in the report with details showing the area, direction of view, description of the photograph, identification of any piping and equipment by tag number and English description and dates of completion.

.2 A Site plan showing the locations of the various pictures shall also be clearly provided. The photographs captions shall be identified on the site plan for referencing purposes.

.3 Records of each testable joints, where applicable.

.4 Records of the hydrostatic pressure test for the installed pipe, where applicable.

.5 Records of the disinfection and neutralization procedure and results, where applicable.

.6 Records of the approval from the regulatory agency/authority, where applicable (e.g. ESA, TSSA, local hydro, gas utilities, etc.).

.7 A copy of the finalized Shop Drawing.

.3 The Contractor shall not commence any backfilling until these reports are submitted by Shop Drawings and approved by the Contract Administrator. The Contractor is required to conduct a site walk through of the installed infrastructure with the Contract Administrator to verify the accuracy of the underground commissioning report.

2. PRODUCTS

2.1 Materials

.1 Products shall be as specified in CW 2030.

3. EXECUTION

3.1 General

.1 Protection:

.1 Before starting Work, locate all utilities serving the Site. Notify all agencies or companies having jurisdiction over the specific utilities and protect, relocate, remove, or discontinue service according to their requirements. Any damages shall be repaired at the Contractor's expense.

.2 Protect and restore pavements, boulevards, grassed areas, etc., that may be opened or damaged in the performance of the Work.

.3 During construction, and at the completion of the Contract, all roads used to haul materials shall be cleaned of materials dropped on them.

.2 Do excavation, trenching, and backfill to CW 2030.

.3 Except as specifically noted on the construction drawings, backfill requirements are as follows:

.1 Beneath, or within 1 m of all existing and proposed pavements, or within 2 m of structures: Class 2 Backfill.

.2 Within boulevard areas, except as noted above: Class 4 Backfill.

.3 Where trenchless installation is specified, backfill shafts with the class of backfill noted on the construction drawings.

.4 Stockpile material to be used for backfilling on Site as directed by the Contract Administrator. Excess material excavated material is to be hauled off site and disposed of by the Contractor.

.5 Use a soft dig excavation method around all existing utilities.

END OF SECTION

SITE WATER UTILITY DISTRIBUTION PIPING

1. GENERAL

1.1 Description

.1 The Work described shall consist of the construction of new potable water mains and potable water service connections, the abandonment and removal of watermain and appurtenances, including the supply and installation of pipe, appurtenances, as well as accessories such as couplings; the hydrostatic testing, and disinfection and bacteriological testing of the pipes used to convey potable water. The Work shall include the provision of any temporary water service piping required to maintain service during construction.

1.2 Related Work

.1 Section 03 30 00 - Cast-in-Place Concrete.

.2 Section 33 05 05 - Excavation, Trenching and Backfilling.

1.3 References

.1 City of Winnipeg Standard Construction Specifications:

.1 CW 2110 Watermains.

.2 CW 2125 Flushing, Hydrostatic Leakage Testing and Disinfection of Watermains and Water Services.

.3 Standard Details – Underground Works.

.2 American Water Works Association (AWWA):

.1 C509: Resilient-Seated Gate Valves for Water Supply Service.

.2 C900: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1500 mm).

.3 CSA:

.1 CSA B137.3, Rigid Polyvinylchloride (PVC) Pipe and Fittings for Pressure Applications.

1.4 Definitions

.1 Appurtenances: Additional piping items as required to provide a complete piping system suitable to convey water as specified and intended. These items may or may not be specified, but are necessary to complete the piping system.

1.5 Submittals

.1 Submit Shop Drawings in accordance with 01 33 00 – Submittal Procedures.

.1 Submittals to include as a minimum the following:

.1 Pipe materials.

.2 Pipe fittings.

.3 Pipe couplings.

.4 Pipe thrust restraint.

.5 Accessories.

.6 Appurtenances.

1.6 Quality Assurance

.1 Materials used for waterlines lines shall be UL listed.

.2 NSF Approval: Material used in the manufacture of HDPE pipe and fittings shall be approved by the National Sanitation Foundation (NSF) for conveying potable water. Pipe and fittings shall bear the NSF label.

2. PRODUCTS

2.1 General

.1 Use only products approved for use in the City of Winnipeg Standard Construction Specifications: Approved Products For Underground Use within the City of Winnipeg.

3. EXECUTION

3.1 Preparation

.1 Clean pipes, fittings, valves, hydrants and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from Site.

.2 Protect all existing buried utilities.

.3 Establish temporary overland water service piping to maintain pressurized water service during construction phases that would interrupt water service. Temporary service is to be installed and maintained in accordance with CW 2110.

3.2 Trenching and Backfill

.1 Do trenching and backfill work to Section 33 05 05.

.2 Sand bedding shall be used with all trenched installations.

3.3 Depth of Burial

.1 The pipe shall be laid to the grade and alignment as indicated on the Drawings. If no specific grades are given or shown on the Plans, the pipe shall be laid at such a depth below the

ground surface that the pipe is provided with an earth cover of no less than 2.75 m above the top of the pipe.

.2 Where crossing above existing utilities precludes maintain the cover specified above insulate piping in accordance with CW 2110 where noted.

3.4 Installation

.1 All installation to be in accordance with CW 2110.

.2 Locate all piping connection points prior to commencement.

.3 Use trenchless methods to install piping beneath existing pavements.

3.5 Pipe Bedding and Initial Backfill

.1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as directed by Contract Administrator.

.2 Shape bed true to grade to provide continuous uniform bearing surface for pipe exterior.

.3 Shape transverse depressions in bedding as required to make joints.

.4 Compact for full width of trench and ensure pipe is uniformly supported throughout its length.

.5 Ensure sufficient cover on pipe to permit backfilling without damage being caused to pipe or initial backfill.

3.6 Removals and Abandonments

.1 Remove hydrants and valves from within the footprint of the building expansion.

.2 Abandon pipes in accordance with CW 2110. Remove tees and replace with straight pipe where branches are to be abandoned.

3.7 Flushing and Hydrostatic Leakage Testing

.1 Flush and perform hydrostatic leakage testing in accordance with City of Winnipeg Standard Construction Specifications CW 2125.

3.8 Disinfection

.1 Disinfect and test potable water lines in accordance with City of Winnipeg Standard Construction Specifications CW 2125.

.2 Maintain the new piping system isolated from the existing system prior to completion of disinfection and receipt of satisfactory bacterial testing results. Only one connection to the existing system will be permitted for filling and flushing the new mains.

END OF SECTION

SANITARY SEWERAGE GRAVITY PIPING

1. GENERAL

1.1 Work Included

.1 The Work included in this Section generally includes, but is not limited to the following items:

.1 Construction of new final effluent pipe from the final effluent channel to beyond the extents of the loading ramp for the storage extension on the UV Facility. In future works, the intention is to extend this final effluent pipe to a new flushing water pump station.

1.2 References

.1 Section 33 05 05 - Excavation, Trenching and Backfilling.

.2 Sections 40 15 13 - Process Piping.

.3 The following specifications of the City of Winnipeg Standard Construction Specifications latest edition are applicable to the Work:

.1 CW 2030 Excavating, Bedding, and Backfill.

.2 CW 2130 Gravity Sewers.

.3 CW 2145 Sewer and Manhole Inspections.

.4 CW 2160 Concrete Underground Structures and Works.

.5 Division 3 Standard Details – Underground Works:

.1 SD-001 Standard Pipe Bedding Classes.

.2 SD-002 Standard Trench and Excavation Backfill Classes.

.3 SD-003 Jetting Nozzle Insertion Locations.

.6 Division 3 Approved Products for Underground Works.

.4 CSA:

.1 CSA B137.3, Rigid Polyvinylchloride (PVC) Pipe and Fittings for Pressure Applications.

2. PRODUCTS

2.1 General

.1 Use only those products listed as Approved Products for Underground Use in the City of Winnipeg in the City of Winnipeg Standard Construction Specification, or as noted herein.

2.2 Secondary Effluent Piping

.1 Polyvinylchloride (PVC) pressure piping iron pipe size (IPS) DR 21 Certified to CSA B137.3 and manufactured in accordance with ASTM D 2241. Fittings to match pipe specifications.

.2 Flexible couplings at connections to structures shall conform to City of Winnipeg Standard CoW-WM-08.

3. EXECUTION

3.1 Excavation, Bedding and Backfill

.1 Do excavation, bedding and backfill to CW 2030.

.2 Pipe bedding shall be Class B compacted sand bedding.

3.2 Installation

.1 Installation to CW 2130.

.2 Connect the existing final effluent channel as per the details on process drawings.

.3 Provide ductile iron bolted sleeve coupling meeting the requirements of CoW-WM-08 at connection to new pipe cored through the effluent channel wall.

.4 Plug end of pipe with pressure rated plug and provide thrust block in accordance with CW 2110.

3.3 Testing

.1 Test shall be witnessed by the Contract Administrator. Provide forty-eight (48) hours advance notice to test date and time.

.2 Perform leakage test in as follows:

.1 Provide all equipment, fittings and labour to complete testing.

.2 Conduct leakage test using air at 35 kPa (5 psi). Test duration shall be fifteen (15) minutes. Acceptable result will be no pressure drop during the fifteen (15) minute test.

.3 Remove temporary fittings and cap after acceptable test.

.3 Provide written report detailing test and results.

END OF SECTION

LAND DRAINAGE SEWER

1. GENERAL

1.1 Work Included

.1 The Work included in this Section generally includes, but is not limited to the following items:

.1 Construction of new land drainage sewers, manholes and catchbasins by open trench and trenchless methods.

.2 Connections to the existing land drainage sewers.

.3 Video inspection of new land drainage sewers.

1.2 References

.1 Section 33 05 05 - Excavation, Trenching and Backfilling.

.2 The following specifications of the City of Winnipeg Standard Construction Specifications latest edition are applicable to the Work:

.1 CW 2030 Excavating, Bedding, and Backfill.

.2 CW 2130 Gravity Sewers.

.3 CW 2145 Sewer and Manhole Inspections.

.4 CW 2160 Concrete Underground Structures and Works.

.5 Division 3 Standard Details – Underground Works:

.1 SD-001 Standard Pipe Bedding Classes.

.2 SD-002 Standard Trench and Excavation Backfill Classes.

.3 SD-003 Jetting Nozzle Insertion Locations.

.4 SD-010 Standard Precast Concrete Manhole (for Up to 525 Diameter Pipe).

.5 SD-011 Standard Precast Concrete Manhole (for 600 to 1500 diameter pipe).

.6 SD-020 Nine Arm Mandrel and Proving Ring for 5.25% Deflection Testing of SDR 35 PVC Pipe.

.7 SD-023 Curb and Gutter Inlet with Catch Pit.

.8 SD-024 Catchbasin with Curb and Gutter Inlet.

.9 SD-025 Standard Catchbasin.

.6 Division 3 Approved Products for Underground Works.

2. PRODUCTS

2.1 Materials

.1 Use only those products listed as Approved Products for Underground Use in the City of Winnipeg in the City of Winnipeg Standard Construction Specification, or as noted herein.

.2 All PVC land drainage sewer piping shall conform to C0W-SM-01. Profile storm sewer piping will not be accepted.

3. EXECUTION

3.1 Excavation, Bedding and Backfill

.1 Do excavation, bedding and backfill to CW 2030.

.2 Pipe bedding shall be Class B compacted sand bedding except as follows:

.1 Bedding and initial backfill for multiple pipes in common trench shall be Type 2 material as specified in Table CW 2030.1.

3.2 Installation

.1 Installation to CW 2130.

.2 Maintain all sewer flows at all times during installation.

.3 Adjust existing manholes frames to grade in accordance with CW 2130.

3.3 Testing

.1 Perform sewer and manhole inspections in accordance with CW 2145.

END OF SECTION

1. GENERAL

1.1 Description

.1 This Section covers items common to sections of Division 40. This Section supplements the requirements of Division 1.

1.2 Codes and Standards

.1 Complete installation in accordance with latest CSA C22.1 except where specified otherwise.

.2 Comply with all laws, ordinances, rules, regulations, codes, and orders of all Authorities Having Jurisdiction relating to this Work.

1.3 Drawings and Specifications

.1 The intent of the Drawings and Specifications is to include all labour, products, and services necessary for complete Work, tested and ready for operation.

.2 These Specifications and the Drawings and Specifications of all other divisions shall be considered as an integral part of the accompanying Drawings. Any item or subject omitted from either the Specifications or the Drawings but which is mentioned or reasonably specified in and by the others, shall be considered as properly and sufficiently specified and shall be provided.

.3 Provide all minor items and Work not shown or specified but which are reasonably necessary to complete the Work.

1.4 Care, Operation, and Start-up

.1 Instruct City maintenance and operating personnel in the operation, care, and maintenance of systems, system equipment, and components.

.2 Provide these services for such period and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.5 Permits, Fees, and Inspection

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of Drawings and Specifications for examination and approval prior to commencement of Work.

.2 Pay associated fees.

.3 Notify the Contract Administrator of changes required by Electrical Inspection Department and Supply Authority prior to making changes.

.4 Furnish a Certificate of Final Inspection and approvals from Electrical Inspection Department and Supply Authority to the Contract Administrator.

1.6 Materials and Equipment

.1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Equipment and material to be CSA certified or cUL certified. Where there is no alternative to supplying equipment which is not CSA or cUL certified, obtain special approval from Electrical Inspection Department and Supply Authority.

.3 Minimum enclosure type to be used is NEMA 12 unless otherwise specified.

1.7 Finishes

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

.1 Paint indoor enclosures light grey to ANSI 61 grey enamel, unless otherwise specified.

.2 Clean and touch-up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

1.8 Equipment Identification

.1 Identify equipment with nameplates as follows:

.2 Nameplates:

.1 Lamicoid 3 mm thick plastic lamicoid nameplates, white face, black lettering, mechanically attached with self tapping screws.

.3 Wording on nameplates to be approved by the Contract Administrator prior to manufacture.

.4 Allow for average of 25 letters per nameplate.

.5 Identification to be English.

1.9 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings on both ends of all conductors and circuit wiring.

.1 Wire tags to be heat shrink type with black letters on white background.

.2 Wire tags to be legible and visible after the system is installed (i.e. not blocked).

1.10 Submittals

.1 Provide submittals as indicated in the individual Specifications and in accordance with Section 01 33 00 – Submittal Procedures and Section 01 78 00 – Closeout Submittals.

1.11 As-Built and Record Drawings

.1 The Contractor shall keep one (1) complete set of white prints at the Site during the Work, including all addenda, change orders, site instructions, clarifications, and revisions for the purpose of recording all changes in the Work. As the Work on-site proceeds, the Contractor shall clearly record in red pencil all as-built conditions, which deviate from the original Contract. As-Built to include circuiting of all devices, conduit, and feeder runs (complete with conductor size and number) and locations of all electrical and automation equipment.

1.12 Operation And Maintenance Manuals

.1 Operation and Maintenance Manuals

.1 Refer to Section 01 78 00 – Closeout Submittals for general operation and maintenance manual requirements.

.2 In addition to the general requirements, provide the following information:

.1 Table of Contents – Arrange contents sequentially by systems under Section numbers. Label tabs of dividers between each to match section numbers in the Table of Contents.

.2 Systems Descriptions – A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.

.3 Manuals containing all pertinent information, drawings, and documents of the Contractor's supply and/or documentation included with the instruments supplied by others, such as:

.1 Mechanical drawings of the equipment.

.2 Installation drawings and procedures.

.3 Instrument model numbers.

.4 Equipment specifications.

.5 Detailed utility requirements.

.6 Replacement parts list with model numbers.

.7 Recommended preventative maintenance frequency.

.8 Troubleshooting procedures.

.9 Procedures for dismantling.

.10 Procedure to operate the equipment/instruments.

.11 Recommended cleaning procedure.

.12 Recommended list of supplies to be used in conjunction with the operation and maintenance of the equipment.

.13 Recommended spare parts list.

.4 A copy of all wiring diagrams completes with wire coding.

.5 Include type and accuracy of instruments used.

.6 Set of final reviewed Shop Drawings.

.7 Testing documentation including:

.1 Loop check report.

.2 Factory Acceptance Test (FAT) report.

.3 Site Acceptance Test (SAT) report.

.2 PLC Software Operation and Maintenance Manual:

.1 Provide a manual that contains, at minimum, all pertinent information, drawings, and documents associated with the PLC program(s) and associated integration, including:

.1 Printout of the entire PLC program(s). Printout to be sealed by the Contractor's professional engineer.

.2 Repair instructions for common issues.

.3 Printout of any related design documents, such as interface lists, etc.

.4 Flash drive in a sleeve containing the latest PLC program including configuration software.

END OF SECTION

1. GENERAL

1.1 Description

.1 This Section describes the pipe materials, fittings, appurtenances, installation and testing of the process mechanical systems.

.2 This Section is to be read in conjunction with the provided bid information. Provide the design of piping supports, pipe guides and expansion joints. Details and structural attachments shown on the Drawings indicate the level of quality that will be considered acceptable.

.3 The Work will be comprised of a variety of process piping. It is the Contractor's responsibility to assess and evaluate the provided Bid information (e.g. process and instrumentation drawings, process control description) and size and select the appropriate pipe work equipment for each application. The Contractor must provide design justification (i.e. process calculation) for choice. Calculations to be signed and sealed by Professional Engineer registered in Manitoba.

.4 The Contractor shall provide the necessary submittals and ensure the proper registration of piping systems and system components as required by Authorities Having Jurisdiction, AWWA, API and ASME requirements.

1.2 Definitions and Interpretations

.1 Pressure terms used in this and other related sections are defined as follows:

.1 Operating Limits: The minimum and maximum pressure at which the piping system operates for sustained periods of time.

.2 Test pressure: The hydrostatic pressure used to determine system compliance.

.2 Unless otherwise specified or shown, the interface between piped commodities common to process/mechanical and yard piping is below grade and 0.5 m from the exterior face of a building or tunnel wall unless otherwise shown.

.3 Pipe and appurtenance location terms used in this and other related sections are defined as:

.1 Tunnels, Pumphouse and Buildings: Within an environmentally controlled enclosure where temperature is maintained above 5°C.

.2 Exposed, Aboveground: Outside or within an enclosure which is not environmentally controlled so that the temperature is maintained above 5°C. For the purpose of defining exterior protection systems, this definition is extended to vertical piping to a point of 0.5 m below finished ground level.

.3 Underground (or buried): Placed in soil and not tied to structures.

.4 Below Structures: Below concrete slabs such as tanks, channels, buildings, pipe chases, foundation slabs, etc., but not including roadways or walkway structures.

.5 Submerged: Regularly or occasionally immersed in liquid; inside tanks and/or channels, and within 3.0 m above maximum water level of open tankage. Includes pipe and appurtenances within manholes, vaults and chambers.

1.3 Submittals

.1 Submit documentation listing pipe, fittings, flexible connectors, expansion joints, linings, coatings, and valving to be used for each pipe size and category.

.2 A copy of this Specification Section and all referenced sections with each paragraph check marked to show compliance or highlighted to indicate deviation.

.3 Submit copies of all original submittals and all related correspondence made as part of the regulatory submission required by all regulatory authorities.

.4 Product Samples: Where specified or when directed by the Contract Administrator, provide mill test results or product samples.

.5 Provide hanger, guide, anchor, support system design details including locations, load information, design calculations and illustrative drawings, stamped and signed by a Professional Engineer registered in the province of Manitoba.

1.4 Coordination

.1 Process and Utility Piping Identification.

.2 Process and utility piping is identified in the Drawings by a two component alpha-numeric code, (Line Label) as follows:

.1 The first component of the code indicates the nominal line size.

.2 The second component of the code identifies the process fluid being conveyed, (Commodity).

.3 The Commodity codes are defined in the Drawings.

.1 Routing: Coordinate piping installation routes and elevations with installation of sheet metal, process equipment, heating ventilation and air conditioning (HVAC), instrumentation, and electrical work.

1.5 Conflicts

.1 Review the Drawings prior to installation of piping, conduit services, and fixtures by this or any other Division. Identify any conflicts and cooperate with the Contract Administrator to determine the adjustments necessary to resolve these conflicts.

.2 Confirm the routing of each section of pipework with other services prior to commencement of installation. Advise the Contract Administrator of any conflicts with existing services or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict and confirm with the Contract Administrator.

1.6 Shipment, Protection and Storage

.1 Deliver pipe, fittings, and specials to site using loading methods which do not damage pipe or coatings.

.2 Piping materials delivered to Site will be clearly marked to indicate size, type, class/schedule and coatings.

.3 Until ready for incorporation in the Works, store on Site as recommended by the piping materials manufacturer to prevent damage, undue stresses, or weathering.

.4 Store materials at least 200 mm above ground with sufficient supports to prevent bending.

.5 Protect non-ultraviolet (UV) light inhibited plastic from sunlight.

.6 Ship pipe expansion joints, anchors, guides and flexible connectors pre-assembled to the degree which is practical.

.7 Provide shipping devices to maintain the face-to-face dimension of each expansion joint during shipment, storage and installation. Design and place shipping devices so as not to inhibit installation of the joints.

2. PRODUCTS

2.1 General

.1 Provide the pipe materials, fittings, and appurtenances as described below, for the piping systems shown in the Drawings.

2.2 Pipe Materials General

.1 All pipe materials to be new, free from defects and conforming to the reference standards identified.

.2 Where any standard referenced has been superseded prior to bidding, the Contractor shall comply with the new standard.

2.3 Pipe and Fittings

.1 General:

.1 Provide eccentric reducers in horizontal lines with the flat side on top, unless shown otherwise.

.2 Provide concentric reducers in vertical lines unless indicated otherwise.

.2 PVC Pipe and Fittings:

.1 Schedule 80.

.2 Material: Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784.

.3 PVC Schedule 80 socket fittings shall conform to ASTM D2467.

.4 Provide pipe and fittings manufactured in compliance to ASTM D1785 meeting and/or exceeding the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.

.5 Provide PVC to CSA B137.3 for all pipe and fittings.

.6 Provide standard lengths of pipe for sizes 10-inch and larger, beveled at each end by the pipe manufacturer.

.7 All potable water pipeline and fittings shall be third party certified to NSF 14.

.8 Joining to be solvent cementing process. Provide flanges where indicated in the Drawings.

.9 Provide Type 316 stainless steel flange bolting and hardware for all piping systems.

2.4 Gaskets

.1 For flat faced flanges, use full-face gaskets.

.2 Use gasket materials for flanged connections suitable for the temperature, pressure, and corrosivity of the fluid conveyed in the pipeline durometer.

.3 Unless otherwise specified, minimum gasket material thickness for full face gaskets:

.1 Greater than 250 mm pipe diameter; 3.2 mm thick.

2.5 Bolts and Nuts

.1 Provide hex head bolts and nuts. Threads to be ANSI B1.20.1, standard coarse thread series.

.2 For general indoor service, use bolts conforming to ASTM A307, Grade A; nuts conforming to ASTM A563, Gr.A.

.3 Provide stainless steel bolts, nuts and washers for exposed, submerged, buried and concrete encased service; bolts conforming to ASTM A193, Gr.B8, C1.1; nuts conforming to ASTM A194, Gr.8. Provide these also for connections above normal water level but which may be subjected to direct contact with splashed water.

.4 Provide hex nuts equal to or less than 25 mm. Greater than 25 mm, provide heavy hex.

3. EXECUTION

3.1 Preparation

.1 Prior to installation, inspect and field measure to ensure that previous work is not prejudicial to the proper installation of piping.

.2 Make all minor modifications to suit installed equipment and structural element locations and elevations.

.3 Advise the Contract Administrator of all modifications. Do not commence work on the related piping until all modifications have been reviewed by the Contract Administrator.

.4 Include any piping modifications in the Shop Drawings submitted prior to fabrication or installation.

3.2 Pipe Handling

.1 Inspect each pipe and fitting prior to installation. Do not install damaged pipe or pipe with damaged protective coatings.

.2 Remove all foreign matter from inside of pipe prior to installation.

.3 Repair pipe with damaged protective coatings with material similar to the original in accordance with the Manufacturer's directions and to the satisfaction of the Contract Administrator.

.4 Use proper implements, tools, and facilities for the proper protection of the pipe. Exercise care in the installation to avoid damage to pipe or coatings.

.5 When lifting sections of large diameter, thin wall piping onto the supports use methods that will prevent damage or deformation. Lift evenly at several places to limit piping deflection between lifting points to a maximum of 6.3 mm.

3.3 Sleeves

.1 Unless otherwise noted or approved by the Contract Administrator, provide sleeves where piping passes through a wall, floor or ceiling.

.2 Locate and place sleeves prior to construction of cast-in-place elements and prior to the construction of concrete and masonry building elements.

3.4 Installation

.1 Fabricate and install pressure piping in interior building spaces in accordance with the ASME pressure vessel code. Fabricate and install domestic hot and cold water piping, sanitary piping and storm drainage piping in accordance with Authorities Having Jurisdiction.

.2 Install as per ASME B31.3, latest edition.

.3 Make adequate provision in piping and pipe support systems for expansion, contraction, slope, and anchorage. Supports, bracing, and expansion joints shown in the Drawings are schematic only. The Contractor is responsible for the design, supply, and installation of the piping system in general accordance with the indicated requirements.

.4 Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag or stress.

.5 Install expansion joints where shown and at other locations as necessary to allow for piping expansion and contraction.

.6 Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves or pipe.

.7 Accurately cut all piping for fabrication to field measurements.

.8 Install pipes in straight alignment. Lateral and vertical misalignment between any three (3) consecutive supports shall not exceed the pipe wall thickness.

.9 Do not exceed 10 mm in 10 m variance from the true alignment, in any direction.

.10 Fabricate and assemble pipe runs so that the pipework is not stressed to achieve the desired alignment and that no stresses are transferred to equipment or equipment flanges. The "springing" of pipework to ensure alignment is not permitted. Undo and subsequently remake all pipework connections to ensure that springing does not occur. Take care not to damage equipment, valves or flanges.

.11 Do not cut or weaken the building structure to facilitate installation.

.12 In parallel pipe runs, offset flanges and/or grooved joint fittings by a minimum of 200 mm.

3.5 Testing

.1 Give the Contract Administrator twenty-four (24) hours notice prior to testing.

.2 Do not insulate or conceal work until piping systems are tested and accepted.

.3 Supply all water, air and inert gases required for pressure testing.

.4 Supply all pumps, compressors, gauges, etc. required for testing.

.5 Install air threadolets, air relief valves and line fitting valves as necessary to complete testing. Remove after testing and plug the threadolets.

.6 Cap or plug all lines which are normally open ended. Remove on completion of testing.

.7 Provide all temporary thrust restraints necessary for testing. Remove upon completion of testing.

.8 Test all underground lines. Do not backfill or place concrete surround until lines are tested and results are accepted by the Contract Administrator.

.9 Test all existing piping where it connects to new piping to the first valve in the existing piping. Repair any failures in existing piping which occur as a result of the test after informing the Contract Administrator of such failure.

.10 Isolate all low-pressure equipment and appurtenances during testing so as not to place any excess pressure on the operating equipment.

.11 Where defective material or equipment is identified, repair or replace using new material.

.12 Release pressure safely, flush and drain liquid pipes after pressure tests. Release pressure safely and purge if needed all gas pipes after pressure tests.

.13 Dispose of flushing water in manner approved by the Contract Administrator, which causes no damage to buildings or siteworks.

3.6 Pressure Testing of Liquid Lines

.1 Hydrostatically test all lines normally used for the conveyance of liquid using water as the test medium.

.2 Test pressures and durations shall be as specified in the detailed specification sheets in Section 40 05 13.01.

.3 Ensure all lines are filled with water. Bleed air from all high spots using the taps provided specifically for that purpose.

.4 Zero leakage is permitted throughout the specified test period for all exposed piping. Refer to Section 40 05 13.01.

.5 Test drains in accordance with Authorities Having Jurisdiction.

END OF SECTION

DETAILED PIPING SPECIFICATION

1. GENERAL

1.1 Work Included

.1 The piping specification sheets on the following pages detail the requirements for each type of process pipe included in the Work.

.2 The piping materials are listed on the Specification Sheets.

1.2 Definition

.1 Abbreviations used in the Detailed Piping Specification Sheets.

Abbreviation	Commodity	Pipe Material
FSW (W3)	Flushing Water	CPVC Schedule 80

2. PRODUCTS

2.1 Schedule

.1 Detailed Pipe Specification Sheets follow.

.2 Connections to be solvent welded per Section 40 05 13.

.3 Transitions between pipe materials are not shown on Contract Drawings and are incidental to Contract Work.

DETAILED PIPING SPECIFICATION

Flushing Water

GENERAL

PROCESS FLUID	SYMBOL	MAXIMUM CONDITIONS		TEST CONDITIONS	
		PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	DURATION (Min.)
Flushing Water	FSW (W3),	400	0-30	600	60

PIPE

LOCATION	SIZE (mm)	MATERIAL	RATING	SPECIFICATIONS	REMARKS
All	10 – 50	PVC	Schedule 80	ASTM D1785, CSA 137.3	

JOINTS

LOCATION	SIZE (mm)	TYPE	MAXIMUM SPACING	SPECIFICATIONS	REMARKS
All	10 – 50	Socket, solvent welded	N/A	ASTM D2467, D2564 ASTM D2467	

FITTINGS AND APPURTENANCES

ITEM	SIZE (mm)	MATERIAL	RATING	SPECIFICATIONS	REMARKS
Flanges	10 – 50	PVC	Schedule 80		
Elbows, Couplings, Tees, Reducers, Reducing Outlets and Laterals	10 – 50	PVC	Schedule 80	ASTM D2467, socket	
ITEM	**SIZE (mm)**	**MATERIAL**	**RATING**	**SPECIFICATIONS**	**REMARKS**
Flange Hardware		316SS			
Flange Gaskets		Neoprene, Viton		ASTM F477	
PVC Solvent				ASTM D2564	

NOTES

1. Provide pipe support. Piping supports are generally not shown on the Drawings, see Section 40 05 80 Process Pipe Hangers and Supports.
2. Male Adapters not to be used with PVC piping.

END OF SECTION

PROCESS VALVES

1. GENERAL

1.1 Description

.1 This Section specifies the supply, installation and testing of process valves.

.2 This Section shall be read in conjunction with the provided process and instrumentation drawings and general arrangement drawings.

1.2 Definitions and Interpretations

.1 Valve Identification:

.1 Valves are identified in the Drawings by valve symbols.

.2 Valve supplier to provide a complete working package for the valve and the actuator, as specified.

1.3 Submittals

.1 Shop Drawings: Submit the following information in accordance with Section 01 33 00:

.1 Catalogue cuts and/or Shop Drawings for each type of valve indicating the valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and valve end configuration.

.2 Operating and Maintenance data for incorporation in Operation and Maintenance Manual, as specified in Section 01 33 00. Include complete description of operation together with detailed Drawings, a complete list of replacement and repair parts, and parts Manufacturer's identifying numbers.

.3 Affidavits and registration numbers described below in Quality Assurance.

1.4 Quality Assurance

.1 Valves are to be marked in accordance with MSS SP-25.

1.5 Shipment, Protection and Storage

.1 Deliver valves to Site and using loading methods which do not damage casings or coatings.

.2 Clearly tag valves stating size, type, coatings and mating parts.

.3 Store on Site until ready for incorporation in the Works using methods recommended by the manufacturer to prevent damage, undue stresses, or weathering.

2. PRODUCTS

2.1 General

.1 Provide valves of the same type, size range and service from a single manufacturer.

.2 Provide new, unused valves for the Works.

.3 Valve materials to be free from defects or flaws, with true alignment and bores.

.4 Unless otherwise indicated on the Process and Instrumentation Drawings or specified in other Sections, valves shall be the same size as the pipe run in which they are to be installed.

.5 Clearly mark valve bodies in raised lettering to indicate the valve type, rating, and where applicable, the direction of flow. Conform to MSS SP25.

.6 Valves to open counter-clockwise.

2.2 Drawings

.1 The process drawings indicate major process valves required for the process to operate as intended.

2.3 Valve Ends

.1 In pipe runs less than 75 mm diameter provide valves with female threaded ends, unless indicated otherwise. Threads to conform to ANSI B1.20.1.

.2 Do not use grooved joint valve ends.

2.4 Manual Operators

.1 Provide valves with manual operators unless specifically indicated otherwise on the process schematic Drawings or mechanical Drawings or other Sections.

.2 Lever operators to conform to the following dimensions:

Nominal Valve Diameter (mm)	Minimum Length of Lever (mm)
6	80
12	80
20	100
38	150
50	150

.3 Quarter turn lever operators to be perpendicular to the pipe run when the valve is closed.

.4 Lever operators on ball valves to be two position.

.5 The maximum pull at the end of the lever arm not to exceed 300 N when one side of the valve is at test pressure and one side is at atmospheric pressure. Where greater than this force would be required to operate the valve with a lever, provide a gear operator. Unless different operators are scheduled or shown in the Drawings, conform to the following minimum requirements:

.1 Ball Valves: less than 150 mm, lever operator; greater than or equal to 150 mm, gear operator.

.6 Gear operator to be worm gear type, equipped with a hand wheel and a visual indicator of the valve position. Equipment operators with adjustable mechanical stop-limiting devices to

prevent over-travel of the disc/ball in the open and closed positions and which are self-locking and designed to hold the valve in any intermediate position between full open and full closed. Gear operators shall be grease lubricated.

.7 Operators for exposed service shall be gasketed for weatherproof service. Place gear boxes above ground and liquid surfaces.

.8 Do not mount valves higher than 1.5 m off the operating floor. For valves located within channels, mount within 300 mm of the top of channel.

2.5 Spare Parts

.1 Provide one (1) spare valve including the appropriate operator for each valve type and size.

.2 Provide a list of all spare parts which would be expected to be required under normal conditions for a period of five (5) years. At the Contract Administrator's request, provide a price for these parts.

3. EXECUTION

3.1 Preparation

.1 The valve and piping arrangement indicated in the Drawings is based on typical dimensions for valves of the specified type. Make the necessary modifications in the piping to allow for discrepancies between the valve dimensions shown and those supplied for the Works.

.2 Prior to the installation of the valves, field measure and check all equipment locations, pipe alignments, and structural installation. Ensure that the valve location and orientation provides suitable access to manual operators and that sufficient space and accessibility is available for electric actuators.

.3 Where conflicts are identified, inform the Contract Administrator and initiate the necessary piping modifications at no cost to the City.

3.2 Valve Installation

.1 In horizontal pipe runs other than in locations where space does not permit, mount all valves with a vertical operating shaft with the actuator at the top. Avoid installing a valve with the operator shaft pointing down.

.2 Mount ball valves with the shaft in a horizontal orientation unless impractical.

.3 Mount valves in a position for easy access to the operators and maintenance personnel.

.4 Support valves in position using temporary supports until valves are fixed in place.

.5 Permanently support valves to prevent transmission of loads to adjacent pipework and/or equipment.

.6 Generally pipe supports and hangers are not shown unless for indication purposes only.

.7 Install valves which are bubble-tight in one direction to seal in a direction opposite to normal flow unless otherwise noted or directed by the Contract Administrator.

.8 Unless otherwise specified, install single seated ball valves with the seat downstream.

.9 Install all valves in accordance with the Manufacturer's recommendations.

3.3 Valve Testing

.1 Ensure that the position indicated by the lever or actuator matches the actual position of the valve.

.2 Operate valves under simulated and/or actual process conditions to ensure they operate as intended.

.3 Pressure test the valves in conjunction with the pipes in which the valves are installed as specified.

END OF SECTION

DETAILED PROCESS VALVE SPECIFICATION SHEETS

1. GENERAL

1.1 Description

.1 Provide the valve type as indicated in the Drawings by the valve symbol shown. See the valve tables attached to this Section for guidance to specific valve types suitable for a given commodity and line size.

1.2 Definitions

.1 Abbreviations used:

.1 BV - Ball Valve.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

DETAILED PROCESS VALVE SPECIFICATION SHEETS

BV

GENERAL						
TYPE OF VALVE	**SYMBOL**	**TYPE OF COMMODITY**	**OPERATING LIMITS**		**DESIGN LIMITS**	
			PRESSURE (kPag)	**TEMP. (°C)**	**PRESSURE (kPag)**	**TEMP. (°C)**
Ball Valve	**BV**	Liquid	400	5 to 40	1000	60

TYPICAL SERVICE
Utility Lines

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	MATERIAL	Reference Document	Material: ASTM D1784 (Grade A)
Body	PVC	Size Range	10 mm to 65 mm
Ball	PVC – floating ball	Rating	CWP 1000 kPag
Packing	O-Ring, EPDM or Viton (Note 4)	Body/Valve Ends	Schedule 80, Female Threaded, True Union
Seats	PTFE	Pattern	Full Port
Shaft	PVC (Note 1)	Operator	Lever
Stem	Blow out proof	Actuator	
		Lining	
		Coating	

NOTES

1. Blowout-proof stem.
2. Bi-directional.
3. This valve is for use in PVC piping systems only.
4. Material to be compatible with commodity.
5. NSF certified.

ACCEPTABLE PRODUCTS

Chemline 21 Series	Hayward Safe-Block	Nibco Tru-Block PVC	Fabco Superbloc
IPEX VX-True Union			

END OF SECTION

PROCESS PIPELINE APPURTENANCES

1. GENERAL

1.1 Description

.1 This Section describes process pipeline appurtenances installed integrally with the piping.

.2 Refer to the general piping requirements of Section 40 05 13 Use the general requirements specified in this Section and Section 40 05 13.

1.2 Submittals

.1 Provide Shop Drawings for each type of pipeline appurtenance in accordance with the requirements of Sections 01 33 00 and 40 05 13.

.2 Show the materials of construction, a cutout indicating the interior workings of the unit, and illustrations of the method of installation.

1.3 Coordination

.1 Coordinate the appurtenances with the piping final layout and arrangement. Ensure that the appurtenances are mounted in locations suitable for their intended function and are accessible for maintenance.

1.4 Quality Assurance

.1 Refer to Section 40 05 13 for quality assurance requirements.

2. PRODUCTS

2.1 Function

.1 Provide the pipe appurtenances as described below, for the piping systems shown.

2.2 Nozzles

.1 Provide flushing water nozzles as specified on the Drawings and in quantities indicated on the Drawings.

3. EXECUTION

3.1 Pipeline Appurtenances

.1 Install nozzles to avoid interference with UV bank when bank is raised out of the channel. Test installation location at each lamp bank and adjust as necessary.

.2 Adjust nozzle direction to ensure proper spray angle and coverage to suppress foaming.

3.2 Testing

.1 Give the Contract Administrator twenty-four (24) hours notice prior to testing.

.2 Do not insulate or conceal work until piping systems are tested and accepted.

.3 Where defective material or equipment is identified, repair or replace using new material.

END OF SECTION

PROCESS PIPE HANGERS AND SUPPORTS

1. GENERAL

1.1 Work Included

.1 Supply and installation of hangers and supports for all process piping systems specified in Section 40 05 13.

.2 Engage a Professional Engineer Registered in the Province of Manitoba to be responsible for the final aspects of the piping support system design, including details and spacing of all supports. The support system will ensure that the weight of the pipework and the need for lateral and vertical support are considered fully. Contractor to provide a complete piping system design as described in Section 40 05 13.

1.2 Submissions

.1 Submit the following for information in accordance with Section 01 33 00:

.1 Indicate hanger and support locations and provide legend summarizing load information and hanger and support component selection at each location. Design shall be sealed by a Professional Engineer in Manitoba.

1.3 Service Conditions

.1 Contractor is responsible for the design and supply of a complete and adequate support system.

.2 Provide hangers and supports specified in this Section to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this Section established pipe support classifications based on the operating temperature of the piping contents.

.3 Pipe support classifications:

.1 Ambient systems:

.1 B-1: 15-49°C.

.2 Cold systems:

.1 C-1: 0.5-15°C.

.2 C-2: minus 40-0°C.

1.4 Hanger and Support Selection

.1 Piping supports are generally not shown on the process or mechanical layout Drawings. Therefore, select pipe hangers and supports as specified in this Section. Typical support details and structural attachments shown on the Drawings indicate the level of quality that will be considered acceptable. Where specific supports are illustrated on the process mechanical or structural Drawings or where a specific standard detail is noted on the Drawings, provide that type of support for that particular pipeline.

.2 Review the final piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.

.3 Hangers and supports shall withstand all static and specified dynamic conditions of loading, including seismic loading, to which the piping and associated equipment may be subjected. As a minimum, consideration shall be given to following conditions:

.1 Weights of pipe, valves, fitting, insulating materials, suspended hanger components, and normal fluid contents.

.2 Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.

.3 Reaction forces due to the operation of safety or relief valves.

.4 Size hangers and supports to fit the outside diameter of pipe, tubing, or where specified, the outside diameter of insulation.

.5 Where negligible movement occurs at hanger locations, use rod hangers for suspended lines, whenever practical. Use bases, brackets, or structural cross members for piping supported from below.

.6 Hangers for the suspension of pipe and tubing sizes 65 mm and larger shall be capable of vertical hanger component adjustment under load.

.7 Provide the supporting systems to allow for free or intended movement of the piping including its movement in relation to that of connected equipment.

.8 Design the system to support the operating loads with a safety factor of 4.0.

.9 Where there is horizontal movement at a suspended type hanger location, select hanger components to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4°.

.10 No contact is allowed between a pipe and hanger or support components of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing with copper-plated, rubber, plastic, or vinyl coated, or stainless steel hanger and support components.

.11 Do not support piping from masonry wall construction.

.12 Do not use existing pipes and supports to support new piping unless otherwise specified.

.13 Do not attach pipe support components to equipment or pressure vessels unless otherwise specified.

.14 Use stock hanger and support components wherever practical.

.15 Provide supplementary structural members, where structural bearings are not in suitable locations.

.1 Make provision for expansion, contraction, slope, and anchorage.

.2 Where necessary, pipe support systems shall withstand the additional load of electrical or instrumentation trays. Coordinate with other Divisions. Design and provide support system accordingly.

2. PRODUCTS

2.1 SUPPORT SPACING

.1 Maximum support spacing shall be as listed in the following table:

Pipe Size Nominal (mm)	Maximum Spacing (m)
	PVC
30 and under	1.4
30 to 40	1.5
40 to 50	1.6

.2 Provide additional supports at any valves or other heavy piping element.

2.2 Materials

.1 In Building, Submerged or Corrosive Environments:

.1 Pipe hangers, supports, structural attachments, fittings, accessories and hardware shall be stainless steel.

.2 Provide AISI, type 316 stainless steel materials.

2.3 Pipe Hangers and Supports

.1 Type 1 - Clevis Pipe Hanger: provide 316SS clevis hangers with configuration and components as follows:

.1 Plastic pipe - B-Line B3100-SS6 or Empire Industries Inc. Figure 11SX

.2 Type 6 - Framing Channel Pipe Clamp: Provide stainless steel pipe clamps as listed below:

.1 Plastic pipe, B-Line B2001-SS4 through B2017-SS4, Powerstrut PS1200-SS Series or Unistrut P2026SS through P2055SS and P2026ST through P2037ST. Provide a copper-plated, plastic coated or lined with a dielectric material on pipe clamps.

Pipe Diameter (mm)	Thickness (mm)
10 to 25	1.6
32 and 38	2.0
50 to 75	2.8
100	3.2

.3 Type 7 - U-Bolt: Provide 316SS U-bolts with configuration as follows:

.1 Plastic pipe – Empire Industries Inc. Figure 137SX, or Eaton Crouse-Hinds UBM50SS though UBM400SS.

.4 Type 11 - Offset Pipe Clamp: provide 316SS pipe clamps with configuration and components as specified and to the most standard design manufactured by a pipe hanger component manufacturer:

.1 Plastic pipe – Empire Industries Inc. Figure 95SX or FM Stainless Fasteners Figure 63.

.5 Type 12 - Riser Clamp: provide stainless steel riser clamps with configuration and components as follows:

.1 Plastic pipe - Grinnell Figure 261SS or Empire Industrial Inc. Figure 50SS.

.6 Type 13 - Framing Channel Pipe Strap: provide 316SS pipe strap with configuration as follows:

.1 Plastic pipe - B-Line B2400-SS6 Series, Powerstrut PS3126-ST, Superstrut C708U-SS6 or Unistrut P2558-ST Series.

.7 Rack and Trapeze Supports:

.1 Unless otherwise specified, provide steel trapeze and pipe rack components having a minimum thickness of 2.8 mm with a maximum deflection 1/240 of the span. Framing channel as specified in Clause 2.3.9.4.

.2 Type 20 - Trapeze Pipe Support: Trapeze pipe support cross members as specified in Clause 2.3.9.4. Provide 41 mm^2 carbon steel flat plate fittings of stranded design manufactured by framing channel manufacturer, B-Line B202-2, Powerstrut PS619 or Unistrut P1062 Series.

.3 Type 21 - Pipe Rack Support: Cross member framing channels, as specified in Clause 2.3.9.4. Provide carbon steel pipe rack fittings of standard design manufactured by framing channel manufacturer. Provide gusset type, 90° fittings, B-Line B844, or Unistrut P2484.

.8 Structural Attachments:

.1 Type C - 316SS Clamp With Extension Piece: Provide 316SS clamp and extension pieces with steel tie rods; Empire Industries Inc. Figure 150SX or Industrial Threaded Products Figure 155.

.2 Type D - 316SS Beam Clamp With Eye Nut: Provide 316SS beam clamps and eye nuts; Grinnell Figure 292, B-Line B3291 series Empire Industries Inc. Figure 450SX or Linn Brown & Associates Figure 14B.

.3 Type G - Adjustable Beam Attachment: Provide 316SS beam attachments, Unistrut P1737-ST, Powerstrut PS2648-ST or Empire Industries Inc. Figure 66SX.

.4 Type H - Double Channel Bracket: Provide single channel attachment as specified in Clause 2.3.9.4. Provide a 316SS double framing channel cantilever bracket assembly; B-Line B297-12SS6 through B297-36SS6, or Unistrut P2542-ST series.

.5 Type J - Single Channel Bracket: Provide single channel attachment as specified in Clause 2.3.9.4. Provide a 304SS single framing channel cantilever bracket assembly; B-Line B198-6SS4 through B198-24SS4, or Unistrut P2231-SS through P2234-SS.

.6 Type K - Wall Mounted Channel: Provide 41 mm x 62 mm 316SS framing channel; B-Line B22-120SS6 or Empire Industries Inc Figure 7000SX.

.7 Type M - Welded Steel Bracket: Provide 316SS brackets which comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket: Empire Industries Inc. Figure 801SX or FM Stainless Fasteners Figure 239.

.8 Type P - Framing Channel Post Base: Provide 316SS post bases of stranded design manufactured by framing channel manufacture. Single channel: Unistrut P2072A-ST, B-Line B280SS6 Powerstrut PS3025-ST. Double channel: Unistrut P2073-ST, B-Line B281SS6 or Powerstrut PS3064-ST.

.9 Accessories:

.1 Weldless Eye Nut: Provide forged steel eye nuts and comply with MSS and FEDSPEC Type 17; Grinnell Figure 290 or B-Line B3200.

.2 Welded Eye Rod: Provide 316SS eye rods with eye welded closed. Inside diameter of eye to accommodate a bolt diameter 3.2 mm larger than the rod diameter; Empire Industries Inc. Figure 26SX or FM Stainless Fasteners Figure 733

.3 Turnbuckle: Provide 316SS turnbuckles; B-Line B3202SS6 or Empire Industries Inc. Figure 320SX.

.4 Framing Channels: Provide 41 mm x 62 mm roll formed 316SS framed channel, having a thickness of 2.7 mm. Channel to have a continuous slot along one side with in-turned clamping ridges. Single Channel: Unistrut P5500-ST Empire Industries Inc. Figure 7000SX or B-Line B22-120SS6. Double Channel: Unistrut P5501-ST or Empire Industries Inc. Figure 7240SX

.5 Anchor bolts to Division 5.

2.4 Hanger Rods

.1 Rod material shall conform to ASTM A307 as a minimum, and shall be cadmium plated in non-corrosive interior spaces, threaded on both ends or continuous threaded and sized as specified.

.2 Hanger rod dimensions, as a minimum shall be as follows:

Pipe Size Nominal (mm)	Hanger Rod (mm)
50	10

3. EXECUTION

3.1 Hanger and Support Location

.1 Locate hangers and supports as near as possible to concentrated loads such as valve, flanges, etc. Locate hangers, supports, and accessories within the maximum span lengths specified on Drawings to support continuous pipeline runs unaffected by concentrated loads.

.2 Provide hangers and/or base supports within 1000 mm of each change in direction on each leg, on one side of each valve, and on the first spool piece or fitting extending from a piece of equipment.

.3 Locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.

.4 Ensure that where piping is connected to equipment, a valve, piping assembly, etc. that will require removal for maintenance, the piping will be supported in such a manner that temporary supports will not be necessary for this procedure.

.5 Support piping so that no pockets will be formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves, and fittings.

.6 Install spring hangers where required to offset expansion in horizontal runs which follow long vertical risers.

3.2 Installation

.1 Welded and bolted attachments to the building structural steel to be in accordance with the requirements of Division 5. Unless otherwise specified, do not drill or burn holes in the building structural steel.

.2 Do not use hanger components for purposes other than for which they were designed. Do not use hanger components for rigging and erection purposes.

.3 All minor modifications to accommodate installed equipment and structural components are subject to review. Do not commence Work on related piping until written acceptance has been received.

.4 Include any piping support modifications on the Shop Drawings submitted prior to fabrication or installation.

.5 Prior to installation, inspect and field measure to ensure that previous Work is not prejudicial to the proper installation of piping.

.6 Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges.

.7 Finished floor beneath Type L structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids or foreign material.

.8 Cut and drill base plates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

.9 Provide plastic or rubber end caps at the exposed ends of all framing channels that are located up to 2100 mm above the floor.

.10 Review the Drawings prior to installation of piping, conduit, and fixtures by this or any other Division. Identify any conflicts and confirm the routing of each section of pipe prior to commencement of installation. Advise of any conflicts with existing services. Where necessary, amend the routing of pipework to avoid conflict and provide Shop Drawings showing proposed routing.

3.3 Adjustment

.1 Adjust hangers and supports to obtain required pipe slope and elevation. Use shims made of material that is compatible with the piping material. Adjust stanchions prior to grouting of base plates.

END OF SECTION

PROCESS CONTROL NARRATIVE

1. GENERAL

1.1 References - General

.1 Instrumentation and Controls, Division 40.

1.2 Introduction

.1 This Section outlines the proposed operation and control strategies for the channel ventilation fans and instruments in the UV Storage Room. Refer to Trojan Shop Drawings for the control philosophy for the UV disinfection system.

.2 It should be noted that these control descriptions are provided as a guide to the intent of the main control strategies. The control system integrator and Contractor must study and take into consideration the City of Winnipeg's standard practices for control system design, graphics objects characteristics, screen layouts, and operator interface features to integrate Trojan UV system, channel ventilation fans and additional HVAC instrument in the UV storage room within existing plant DCS system.

.3 All aspects of the new control sequences, operator interface, and remote monitoring must be thoroughly tested in cooperation with the City of Winnipeg and the Contract Administrator to demonstrate correct functioning of all control system features and to verify that all new interlocks and alarms are functioning properly.

.4 All inputs shall be viewable for trending.

2. OPERATING DESCRIPTION

2.1 Trojan UV System

.1 The UV system is supplied with its own system control center (SCC, tag named CP-U1000), control philosophy and will automatically monitor and control each UV channel based on incoming flow, UV transmittance and dose setpoint.

.2 Under normal operating conditions, all three channels will be in service. Lamp output will modulate based on the UV system control philosophy.

.3 For more information on the UV disinfection system, refer to the control philosophy provided by the vendor.

.4 UV SCC will be tied to NEWPCC PCS to provide monitoring, alarm status and control of the UV system via SCADA.

.5 Coordinate with the City operation and Contract Administrator to integrate UV system alarms to existing plant SCADA for remote monitoring of the UV system.

2.2 UV Building

.1 Channel Ventilation Fans:

.1 There are two channel ventilation fans (EF-U6001 and EF-U6002).

.2 Both fans are equipped with variable frequency drives (VFDs) to allow modification of fan speed, if needed.

.3 The fans will initially be set at 75%, or as directed by the air balancing Contractor to ventilate the channel headspace directly outdoors and provide a slight negative pressure inside the UV Building.

.4 Once the fan speed is set, the fans will run continuously at the set speed.

.5 All fans will have 3 control modes that can be selected at the VFD on the MCC keypad.

.1 Hand: In hand mode the fan can be turned on and off from the keypad and the speed can be set. A status signal indicating the VFD is not in remote is sent to the PCS.

.2 Remote: In remote control mode the VFD is controlled from signals from the controller. There are three modes of control from the PCS:

.1 Remote Manual: In remote-manual mode the fans can be turned on and off and the fan speed can be set by the operator from the SCADA HMI.

.2 Remote Automatic: In remote-automatic mode the fans will run continuously at the last pre-set speed.

.3 Remote Off: When in remote-off mode the fan remains off.

.3 Off: When in off control mode the fan remains off and signals from the PCS are ignored. A status signal indicating the VFD is not in remote is sent to the PCS.

.6 Failure of Channel Ventilation Fans will raise a fault alarm to the SCADA system to notify the operation.

.2 Eyewash Station:

.1 The eyewash flow switch (FSH-U5001) will raise an alarm when flow is detected.

.2 Flow switch status alarm will be sent to the SCADA system.

.3 Building Temperature:

.1 The UV Storage Room temperature is monitored by an ambient temperature transmitter (TT-U6501).

.2 If the UV Storage Room temperature, as measured by TT-U6501 drops below an operator adjustable temperature (initially 18°C) a BUILDING LOW TEMP alarm will be raised.

.3 If the UV Storage Room temperature, as measured by TT-U6501, rises above an operator adjustable temperature (initially 35°C) a BUILDING HIGH TEMP alarm will be raised.

.4 Smoke/Heat Detection:

.1 If a smoke or heat detector is activated an alarm will be raised SMOKE/HEAT ALARM. The alarm control will begin calling out immediately.

.5 Overhead Door:

.1 Overhead door open/closed status signal will be provided to the SCADA and Open alarm will be raised when the door is Open.

2.3 Alarm Conditions

.1 Fail to Start Alarm:

.1 If a fan is in remote control mode and called to start by the PLC, if the run status does not indicate the fan is running within thirty (30) seconds a FAIL TO START alarm will be raised and the fan will be set to out of service.

.2 Fault:

.1 If any equipment is faulted, a FAULT alarm for the equipment will be raised.

.3 Loss of Signal:

.1 If any 4-20mA input signal goes below 4mA or above 20mA, a LOSS OF SIGNAL alarm will be raised for that device.

.4 Deadband:

.1 Provide appropriate signal deadbands to prevent nuisance operation.

.5 Interlocks:

.1 Provide process interlocks as per vendor system requirements.

.6 Loss of Communication:

.1 If communication signal is lost, LOSS OF COMMUNICATION alarm will be raised on SCADA and the equipment to retain last status and operation setpoint.

END OF SECTION

INSTRUMENT INDEX

1. GENERAL

1.1 Description

.1 Provide Instrumentation for Process Systems as specified in this section and in compliance with related detailed instrumentation specification sections and Contract Documents.

.2 The Work of this section includes the provision of instrument data sheets for all instruments supplied for this project. The contractor shall provide an as-constructed instrument data sheet for each instrument supplied for this project based on the ISA S20 standard for instrument specification forms.

1.2 Submittals

.1 Prepare and submit Instrument Data Sheets for each instrument supplied for this project in accordance with the ISA S20 standard. Clearly indicate all pertinent data for the respective instrument on the data sheets and clearly indicate any deviations from specified requirements. The completed Instrument Data Sheets shall be submitted together with and form an integral part of the instrumentation Shop Drawings specified in this Division.

2. PRODUCTS

2.1 Instrument Index

.1 The table provided in Appendix G – Instrumentation List is an itemized list of instrumentation to be supplied for this project. The instrumentation index provides detailed information for the tagged instrumentation devices shown on the P&ID diagrams.

3. EXECUTION

3.1 Instrument Data Sheets

.1 Contractor shall update the Instrument Data Sheets to reflect all changes in the work, and as required based on shop drawings that have been returned from the Contract Administrator with a “No Exceptions Taken” or “Make Corrections Noted” status.

.2 The as-constructed set of instrument data sheets shall be included in the O&M manual submittal.

3.2 Instrument Index

.1 Contractor shall update the Instrument Index to reflect all changes in the work, and as required based on Shop Drawings that have been returned from the Contract Administrator with a “No Exceptions Taken” or “Make Corrections Noted” status.

.2 The as-constructed Instrument Index shall be included in the O&M manual submittal.

3.3 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

PROCESS TAPS AND PRIMARY ELEMENTS

1. GENERAL

1.1 References – General

.1 Section 40 90 00.

2. PRODUCTS

2.1 Process Taps

.1 Provide pressure gauge and thermowell taps. Coordinate requirements with other Divisions.

2.2 Primary Elements

.1 Provide primary elements and transmitters.

.2 Provide written assurance that the instrument manufacturer approves the selection of materials of primary elements, which are in contact with the specified process fluid and inert to the effects of the process fluid.

.3 Provide drip pots installed below sensing elements measuring gas. Provide seamless, stainless steel drip pots consisting of a 50 mm by 300 mm pipe with an isolating valve and a drain valve. Provide a separate drip pot for each sensing line. Locate the drain valve within 500 mm of the floor.

.4 Provide diaphragm seals on any fluid other than clean water or glycol.

.5 When diaphragm seals are specified with a pressure gauge or a pressure switch provide the assembly filled with ethylene glycol and calibrated by the manufacturer.

.6 When line-sized in-line pressure sensors are specified with a pressure gauge or a pressure switch (or combination of both), provide ethylene glycol filled assembly calibrated by the manufacturer.

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section gives general requirements for Instrumentation and Control related items. It is supplemental to the requirements defined in other Specification Sections.

.2 Comply with latest edition of all applicable codes and standards whether referenced in this Section or not.

.3 In the event any inconsistency is discovered between the Specifications, codes or standards, the most stringent shall apply.

1.2 General Requirements

.1 Refer to Division 1 for General Requirements related to the Contract Documents.

.2 Refer to all Sections of the Tender, Division 26, 40, Drawings, and Appendices.

.1 The intent of the Specifications and Drawings is to include all labour, products, and services necessary for complete Work, tested, commissioned and ready for operation.

.2 Symbols used to represent various electrical devices often occupy more space on the Drawing than the actual device does when installed. In such instances, do not scale locations of devices from electrical symbols. Install these devices with primary regard for usage of wall space, convenience of operation and grouping of devices. Refer to installation details where they exist.

.3 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of the present specifications.

1.3 References

.1 The following is a list of codes and standards are applicable as required:

.1 Institute of Electrical and Electronics Engineers (IEEE):

.1 C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

.2 IEEE 802.3u, 100BASE-TX, 100BASE-FX Ethernet at 100 Mbit/s.

.3 IEEE 802.3z, 1000BASE-X Gbit/s Ethernet over Fibre Optic.

.4 IEEE 802,3ab, 1000BASE-T Gbit/s Ethernet over twisted pair.

.5 IEEE 802,3x, Flow Control.

.2 The International Society of Automation (ISA):

.1 S5.1, Instrumentation Symbols and Identification.

.2 S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.

.3 62443, Security for Industrial Automation and Control Systems.

.3 Canadian Standards Association (CSA):

.1 C22.1 Canadian Electrical Code.

.2 C22.2, Electrical Safety Code.

.4 National Electrical Manufacturers Association (NEMA).

.5 National Fire Code, National Fire Protection Association (NFPA):

.1 NFPA 820, Fire Protection in Wastewater Treatment Plants.

.2 Comply with the following City of Winnipeg Standards documents:

.1 Automation Design Guide.

.2 Electrical Design Guide.

.3 HMI Layout and Animation Plan.

.4 Identification Standard.

.5 Tag Naming Standard.

.6 Winnipeg Electrical By-Law.

.7 Information Bulletins.

.3 Manitoba Hydro:

.1 Manitoba Electrical Code, most current adopted revision.

.2 Manitoba Hydro Inspection Notices.

1.4 Acronyms and Abbreviations

.1 CP: Control Panel.

.2 DCS: Distributed Control System.

.3 FAT: Factory Acceptance Test.

.4 FOCS: Fibre Optic Communication Subsystem.

.5 HVAC: Heating, Ventilating, and Air Conditioning.

.6 I&C: Instrumentation and Control.

.7 I/O or IO: Input and Output.

.8 HMI: Human-Machine Interface, alias for Operator Interface.

.9 LCP: Local Control Panel.

.10 MCC: Motor Control Center.

.11 NP: Network Panel.

.12 O&M: Operation and Maintenance.

.13 OWS Operator Work Station.

.14 PC: Personal Computer.

.15 PCS: Process Control System comprising PLC's, and HMIs, communications systems and related hardware and software.

.16 PCU: Process Control Unit, a DCS subsystem.

.17 PCS: Process Instrumentation and Control System.

.18 P&ID: Process and Instrument Diagram.

.19 PLC: Programmable Logic Controller.

.20 SAT: Site Acceptance Test.

.21 SIT: Site Integration Test.

.22 SIFT: System Integration Functional Test.

.23 UPS: Uninterruptible Power Supply.

.24 VFD: Variable Frequency Drive.

.25 See the Identification Standard for further Abbreviations.

1.5 Supplemental Documents

.1 Documents related to the Automation Work:

.1 Process Control Narratives.

.2 Instrument Lists:

.1 Instrument lists are provided to aid the Contractor's work. If there are any discrepancies between these documents and the Drawings and Specifications, the Drawings and Specifications shall take precedence.

.3 IO Lists:

.1 IO lists are provided to aid the Contractor's work. If there are any discrepancies between these documents and the Drawings and Specifications, the Drawings and Specifications shall take precedence.

.4 Instrument Datasheets:

.1 See Section 40 91 01 - Instrumentation and Control Components for details on datasheets.

.5 Cable Lists.

1.6 Submittals

.1 General:

.1 Submit proposed Submittal breakdown list consisting of all PCS component submittals. Sequencing and packaging of information to be in accordance with Progress Schedule.

.2 Submit sequence plan to intergrade new PCS equipment, package systems and process instrumentation to existing plan PCS.

.3 Partial Submittals not in accordance with Progress Schedule will not be accepted.

.4 Obtain Contract Administrator's approval if Submittals for a PCS subsystem is to be made in multiple packages.

.5 Provide submittals sufficiently in advance of requirements to allow ample time for review.

.6 Mark Shop Drawings and data submitted showing only items applicable to specific contract. Complete catalogues that have not been curated to the specific products submitted will be rejected.

.2 Shop Drawings and Product Data:

.1 Prior to delivery of any Products to job site, submit Shop Drawings and Product Data as specified in Section 01 33 00, Submittal Procedures for all equipment as required in the Specifications.

.2 Prior to submitting the Shop Drawings to the Contract Administrator, the Contractor shall review the Shop Drawings to determine that the equipment complies with the requirements of the Specifications and Drawings.

.3 The term "Shop Drawing" means drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data, which are to be provided by the Contractor to illustrate details of a portion of the Work. Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be

supplied and installed. Indicate cross-references to design drawings and specifications. Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract price. If adjustments affect the value of the Work, state such in writing to the Contract Administrator prior to proceeding with the Work.

.4 Equipment identifiers shall be included on all Shop Drawings and product data submittals to clearly identify the equipment they apply to.

.5 Provide CSA or cUL certified equipment and material.

.6 Manufacture of Products shall conform to revised Shop Drawings.

.3 Informational Submittals:

.1 Provide informational submittals in accordance with other Specification Sections including but not limited to the following:

.1 Training Plan: In accordance with other Specification Sections.

.2 Testing and Commissioning Forms: In accordance with other Specification Sections.

.3 Operation and Maintenance Data: In accordance with Section 01 91 31, Commissioning Plan and in addition to the following:

.1 Outline of O&M data.

.2 Sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for each PCS component.

.4 As-Built Drawings: In accordance with Section 01 78 00, Closeout Procedures.

.2 Extra Materials:

.1 List of proposed spares, expendables, and test equipment. Separate Submittals for each PCS subsystem.

.2 Recommended Spare Parts: List of, and descriptive literature for, additional spares, expendables, and test equipment recommended by PCS Integrator. Include quantities, unit prices, and total costs.

1.7 Drawings and Specifications

.1 The intent of the Drawings and Specifications is to indicate labor, products, and services necessary for a complete, installed, tested, commissioned and functional installation.

.2 PCS drawings may indicate approximate route to be followed by conduits and cables and general location of electrical equipment. They do not show all structural, architectural, and mechanical details. The details on exact cable or conduit routing, and exact equipment installation location is to be determined on site and coordinated with all other trades.

.3 To provide sufficient detail and maximum degree of clarity on the Drawings, symbols used for various electrical devices, particularly wall mounted devices, take up more space on the drawings than devices physically do. Locate devices with primary regard for convenience of operation, accessibility and space utilization, rather than locating devices to comply with the exact scaled locations of the electrical symbols.

.4 The PCS specifications and Drawings and the Specifications of all other Divisions shall be considered as an integral part of the work. Any item or subject omitted from either the Specifications or the Drawings but which is mentioned or reasonably specified by the Drawings or Specifications of other Divisions, shall be considered as properly and sufficiently specified and shall be provided.

.5 If discrepancies or omissions in the Drawings or Specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting a bid.

.6 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

.7 Various package unit types of equipment are included in the work. It is the responsibility of the Contractor to familiarize himself with the requirements of the equipment vendor, and to include all materials and labor for a complete and working installation. In some cases this means that control panels, instruments, actuators, etc. need to be wired and connected in the field. The Contractor shall include all costs to perform such services as part of his tender submittal. Coordination between the equipment vendor and the Contractor shall be performed prior to tender bid closing date, and all costs shall be included in the tender. Request for extras due to lack of coordination between the Contractor and the equipment vendors will not be accepted.

.8 Cables schedules / lists where shown do not include all cables required to perform the complete facility installation. They shall be used as a general guide. Accurate cable lists, quantities, take-offs remain the responsibility of the Contractor.

1.8 Care, Operation, and Start-up

.1 Instruct City maintenance and operating personnel in the operation, care and maintenance of systems, system equipment and components.

.2 Where services of a manufacturer’s factory service engineer is required, arrange and pay for services to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with all aspects of its care and operation.

1.9 Permits, Fees and Inspection

.1 The Contract Administrator will submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of Work.

.2 The Contractor shall pay associated fees as required by the Electrical Inspections and Permitting department.

.3 Notify the Contract Administrator of changes required by Electrical Inspection Department prior to making changes.

.4 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.

1.10 Materials and Equipment

.1 Provide materials and equipment in accordance with Section 01 61 00, Common Product Requirements.

.2 Equipment and material to be CSA or cUL certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.

.3 Minimum enclosure type to be used is NEMA 12 unless otherwise specified.

.4 Junction Boxes:

.1 All field wiring connections to be located in junction boxes with terminals. The design documents show the expected junction boxes to be required. However, the Contractor must provide all junction boxes required, whether or not the junction boxes are shown in the design documents.

1.11 PCS Coordination

.1 Coordinate work with all other trades to ensure that conflicts do not occur.

.2 Coordinate requirement of mechanical equipment requiring electrical connection with the mechanical contractor.

.3 Coordinate work with City plant operation and maintenance.

.4 Coordinate work with other projects on Site.

.5 Coordinate integration of the new systems and instrumentation City AICG team.

1.12 Finishes

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

.1 Paint enclosures light grey to ANSI 61 grey enamel, unless otherwise specified.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

.4 Refer to Section 09 91 00, Painting and Coating for additional information.

1.13 Equipment Identification

.1 Identify PCS equipment with nameplates.

.2 All identifiers shall be consistent with the most recent version of the City of Winnipeg Water and Waste Department Identification Standard 510276-0000-40ER-0002 and as shown on Drawings.

.3 Nameplates:

.1 Lamacoid, 3 mm thick plastic nameplates, mechanically attached with self tapping stainless steel screws, white face with black lettering. Note: “Sheet Metal Screws” or other sharp pointed screws are NOT acceptable.

.2 Sizes as follows:

Table 1.1: Nameplate Sizes

Size	Dimension	Lines of Text	Text Height
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	40 x 90 mm	2 lines	8 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	5 mm high letters
Size 8	35 x 100 mm	3 lines	5 mm high letters
Size 9	45 x 100 mm	4 lines	5 mm high letters
Size 10	75 x 160 mm	3 or 4 lines	8 mm high letters
Size 11	150 x 250 mm	3 or 4 lines	10 mm high letters

.3 Wording on nameplates to be approved by Contract Administrator prior to manufacture.

.4 Allow for average of fifty (50) letters per nameplate.

.5 Identification to be in English.

.4 Provide nameplates for the following, sizes as shown:

.1 Cabinets – Size 8.

.2 Small Junction Boxes (150 mm x 150 mm or smaller) – Size 1.

.3 Large Junction Boxes – Size 2.

.4 Control panels – Size 8.

.5 Field Devices (Instruments, Actuators, etc.) – Size 4.

1.14 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Wire tags to be heat shrink type with mechanically printed black letters on white background.

1.15 Conduit and Cable Identification

.1 Colour code conduits, boxes and cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.

.3 Colours: 38 mm wide prime colour and 19 mm wide auxiliary colours.

Table 1.2: Conduit and Cable Colour Code

System	Prime Band	Aux. Band
Medium Voltage (>750 V)	Orange	
347/600 V	Yellow	
120/208/240 V Power	Black	
UPS 120/208/240 V Power	Black	Green
Control Wiring (120 V)	Black	Orange
Fire Alarm	Red	
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring (<50 V)	Blue	Orange
Intrinsically Safe	Blue	White
Ground	Green	
Fibre Optic	Purple	

.4 Cable Identification: Supply and install lamacoid type cable identification tags for all cables. Install identification tag at both ends.

1.16 As-Built Drawings and Documents

.1 Refer to Section 01 78 00 – Closeout Submittals for additional requirements for As-Built Drawings and documents.

.2 The Contractor shall keep one (1) complete set of white prints at the Site during the work, including all addenda, change orders, Site Instructions, clarifications, and revisions for the purpose of As-Built Drawings. As the Work on-site proceeds, the Contractor shall clearly record in Red Pencil all as-built conditions, which deviate from the original Contract Documents.

.3 The Contractor shall keep one (1) completed set of automation documents at the Site during the work, including all addenda, change orders, Site Instructions, clarifications, and revisions for the purpose of As-Built documents. This includes, but is not limited to the following:

.1 IO Lists.

.2 Instrument Lists.

.3 IP Address Lists.

.4 Automation Equipment List.

.4 On completion of the work, minimum of four (4) weeks prior to final inspection, submit As-Built Drawings and documents to Contract Administrator for review. The Contractor shall certify, in writing signed and dated, that the As-Built Drawings are complete and that they accurately indicate all electrical services, including exposed as well as concealed items.

.5 Comply with all other City of Winnipeg standards and requirements.

1.17 Operation and Maintenance (O&M) Manuals

.1 Provide operation and maintenance manuals as specified herein and in accordance with the general conditions. Refer to Section 01 91 31 - Commissioning Plan.

.2 Include in the operations and maintenance manuals a minimum of:

.1 Cover page including project name, year, name of owner and electrical Subconsultant. Cover page shall be enclosed in a clear plastic cover.

.2 Index.

.3 List of manufacturers and supplier for all items.

.4 Names, address and phone number of all local suppliers for items included in maintenance manual.

.5 Stamped and signed Shop Drawings.

.6 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of portions or features of the installation.

.7 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.

.8 All test results performed. This includes, but is not limited to fibre optic tests; Control System network tests; Profibus Network Tests; FAT, SIFT, SIT and SAT tests.

.9 PLC and HMI Programs on USB memory stick.

.10 As-Built Drawings.

.11 Signed and dated warranty certificate.

.12 Signed and dated approval by the local Electrical Inspections Department.

.13 All other requirements outlined in the specifications.

.3 Submit draft document prior to the start of commissioning.

1.18 Environmental Conditions

.1 Equipment and systems are to be rated to correctly operate in the environment in which they are to be installed.

.2 Exterior devices shall be rated to operate in an exterior environment with temperature range of -40°C to +40°C.

1.19 Quality Assurance

.1 Qualifications:

.1 For work involving specialties, including, but not limited to, the installation of sound and intercommunication systems, fire alarm systems, lightning protection systems, grounding systems, instrumentation, controls, electronic access, security systems, fibre optics systems, etc. employ only workers fully trained, qualified and experienced in the aspects of such work.

2. PRODUCTS

2.1 General

.1 The design is based upon the manufacturers and model numbers shown on the drawings and in the specifications. If a manufacturer chosen after project award is different from that on which the design is based, the design must be modified by the Contractor based on the chosen manufacturer. If additional engineering work is required, the Contractor must provide an Engineer's seal for the change to the design.

.2 The City has standardized on a specific vendor for the supply and delivery of control system and motor control equipment. The Standardization Vendor was selected via RFP 756-2013 and was awarded to Schneider Electric Canada Inc. (Schneider). Refer to City standardized goods agreement for details.

.3 The City has standardized on a specific vendor for the supply and delivery of specific instrumentation. The Standardization Vendor was selected via RFP 449-2014 and was awarded to Trans-West Supply Company Inc. (Trans-West). Refer to City standardized goods agreement for details.

.4 Substitutes:

.1 Provide all additional and modified wiring, raceway, enclosures, intrinsically safe barriers, and accessories at no additional cost associated with approved substitutes.

.5 Like equipment items:

.1 Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.

.2 Implement all same or similar functions in same or similar manner. For example, control logic, sequence controls, and display layouts.

3. EXECUTION

3.1 Preparation and Protection

.1 Schedule expediting of materials and execution of work in conjunction with associated work of other trades in order to meet the required work schedule.

.2 Post engraved warning signs to meet requirements of local by-laws, Inspection Authority and Contract Administrator.

.3 Protect those working on or in vicinity of exposed electrically energized equipment from physical danger. Shield and mark live parts in accordance with local regulations. Indicate the appropriate voltage.

.4 Arrange for installation of temporary doors, barriers and similar items for access to rooms and areas containing electrical equipment. Keep these doors locked at all times, except when under direct supervision.

.5 Permanently identify with lamacoid nameplate, equipment energized from multiple power sources, noting voltages, power source locations, supply disconnect designations and grounding electrode location.

3.2 Warning Signs

.1 As specified and to meet the requirements of Electrical Inspection Department and the Contract Administrator.

.2 Lamacoid 3 mm thick plastic engraving sheet, red face, white core, mechanically attached with self tapping screws, 20 mm text.

3.3 Mounting Heights

.1 Unless otherwise noted, or in contravention of codes and standards, mount equipment replacing existing equipment at the same height.

.2 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.

.3 Typical mounting heights are as follows:

.1 Wall mounted instruments: 1.5 m Above Finished Floor (AFF).

.2 Wall mounted junction boxes: 1.5 m AFF.

.3 Wall mounted small panels: 1.5 m AFF.

.4 Wall mounted large panels: Top of cabinet at 2.0 m AFF.

.5 Gas detection horns and strobes: 2.0 m to 4.0 m AFF.

.6 Motor control hand switches: 1.5 m AFF.

.7 Valve actuator control stations: 1.5 m AFF.

.4 If mounting height of equipment is not indicated, verify with the Contract Administrator prior to proceeding with the installation.

3.4 Modifications to Existing Cabinets

.1 Where significant modifications are made to existing cabinets, the cabinet shall be inspected by the Authority Having Jurisdiction.

3.5 IP Addresses

.1 IP Addresses will be provided to the Contractor for all network devices after project award. The Contractor will be required to sign a Non-disclosure Agreement and confidentiality agreement in relation to the IP Addresses.

3.6 Devices with Integral Leads

.1 For devices with integral leads, if the location of the device does not allow the leads to reach the junction box as shown on the drawings, provide additional wiring, conduit and boxes as required to extend the leads to the associated junction box.

3.7 Location of Devices

.1 Allow for change of location of devices at no extra cost or credit, provided that the distance does not exceed 3000 mm (10') from that shown on the drawings, when the requirement is made known prior to installation.

3.8 Conduit and Cable Installation

.1 Sleeves through concrete: schedule 40 galvanized steel pipe, sized for free passage of conduit.

.2 For wall, partitions, and ceilings the sleeve ends shall be flush with the finish on both sides but for floors they shall extend 25 mm (1") above finished floor level.

.3 Fire stop opening with ULC approved assembly for the installation conditions.

.4 Provide a detailed proposed conduit routing plan to the Contract Administrator prior to proceeding with the installation of conduit.

.5 If possible, avoid routing conduits through hazardous area.

.6 Separate cables of different voltage levels when cables are installed parallel to each other.

3.9 Cutting, Patching, and Drilling

.1 Provide all cutting and patching as required.

.2 Return exposed surfaces to an as-found condition.

.3 Exercise care where cutting/drilling holes in existing concrete elements so as not to damage existing reinforcing, or any other systems run in the concrete.

.1 Locate reinforcing and other existing systems using ground penetrating radar, X-Ray or other suitable means. Mark out on the surface of the concrete the locations of rebar and all other systems.

.2 For all holes larger than 50 mm passing through reinforced concrete, mark the location of the desired hole and all embedded systems. Obtain approval from the Contract Administrator prior to cutting.

.4 Firestop and seal all penetrations.

.5 Ensure that water ingress will not occur.

.6 Provide expansion joints for penetrations where shifting can occur.

3.10 Anchor Installation

.1 The Contractor shall exercise care where installing anchors into existing concrete elements so as not to damage existing reinforcing. All anchors shall be installed utilizing carbide tip drill bits. The existing reinforcing shall be located utilizing a reinforcing bar locator and marked out on the surface of the concrete. The drill holes shall be advanced to the required depth for installation of the anchors. Should reinforcement be encountered while drilling, the hole shall be terminated and repositioned to clear the reinforcement. Do not use core bits that can easily intercept and damage/cut the reinforcing during drilling.

3.11 Field Quality Control

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties. A maximum of one apprentice is permitted per qualified electrician.

.2 The Work of this Division to be carried out by a Contractor who holds a valid Master Electrical contractor license as issued by the Province of Manitoba.

3.12 Touch-Up Painting

.1 Clean and touch up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Obtain necessary touch-up paint of original type and quality from equipment manufacturer.

.3 Clean surfaces to be painted. Feather out edges of scratch marks. Make patch inconspicuous.

.4 Apply one (1) or more coats until damaged surface has been restored to original finish condition.

.5 Clean and prime exposed non galvanized hangers, racks and fastenings to prevent rusting.

.6 Do not paint nameplates, tags, CSA labels, warning plates and operating instructions. Observe field painting of electrical equipment or raceways. Labels shall be visible and legible after the equipment is installed.

3.13 Cleaning

.1 Clean construction debris and materials from enclosures, before final electrical tests. Vacuum the interior and exterior of enclosures to ensure all equipment is free from debris. No loose items shall be in the bottom of cabinet before the final electrical tests. Any spare parts, drawings, documentation, etc. should be stored in the appropriate area in the cabinet.

3.14 Provision for Future Expansion

.1 In each location where space for future equipment is indicated, leave such space clean. Install conduit, wiring and other work in such a manner that necessary connections can be made in future without dismantling existing equipment, raceways or wiring. Consult with Contract Administrator whenever necessary.

END OF SECTION

FIELD SERVICES

1. GENERAL

1.1 Scope of Work

.1 This Section describes the requirement for field services required to place, install, wire, connect, test, verify and document the installation of all components and related training.

.2 Provide all labour, equipment and materials required for the installation, testing and commissioning, and start-up of UV system.

.3 Cooperate and coordinate with the City, the PCS system integrator, and other contractors to fully test and commission all components of the UV upgrade.

.4 Provide network connections and power supply connections, from the electrical distribution panels for all equipment requiring power.

.5 Coordinate the installation of equipment with Division 26.

.6 Coordinate the field instrumentation requirements with other Divisions.

1.2 Submittals

.1 Submit the proposed forms for documenting the checkout and verification phases of all of the Work.

1.3 Qualifications

.1 Provide a qualified, factory authorized field-service representative for the installation and set-up of new equipment.

.2 Provide the services of qualified installers for any equipment and communications cable required to and from the patch panels to the PLCs, MCCs and PCS.

.3 For installation of field raceways and wiring use qualified trades people.

2. PRODUCTS

2.1 Equipment and Materials

.1 Provide all equipment and materials necessary for the un-loading, handling, placement, installation and testing of all control system equipment.

3. EXECUTION

3.1 Installation

.1 Provide for the off-loading and placement of all equipment in the field.

.2 Inspect equipment for mechanical and electrical damage prior to shipping, arrival at Site, during unpacking and after final placement of equipment. Replace or repair any damaged equipment to the satisfaction of the Contract Administrator.

.3 Prepare damage reports and make all claims against the carrier.

.4 Provide adequate protection for the equipment after installation. Do not install equipment in locations that are not sufficiently complete to maintain the proper environmental conditions for the equipment.

.5 Certify in writing that equipment has been installed as per Drawings and recommended installation procedures. Report any discrepancies to the Contract Administrator.

.6 Provide and install the AC power supply from the distribution panels and connect to systems ground for the equipment. Certify in writing that equipment power and grounding requirements have been satisfied. Report any discrepancies.

.7 Certify in writing that field wiring is properly installed and correctly identified. Report any discrepancies to the Contract Administrator.

.8 Make adjustments necessary to place equipment in trouble-free operation. Submit any amendments to calibration certificates to the Contract Administrator.

.9 Certify that the system is ready for field testing.

.10 Update and submit to the Contract Administrator or the As-Built Drawings and CAD files for the installed systems.

END OF SECTION

1. GENERAL

1.1 References

.1 Comply with latest edition of the codes and standards applicable and/or referenced in Section 40 90 00, Instrumentation and Control for Process Systems 1.3 and this Section.

.2 The following is a list of standards which may be applicable in this Section:

.1 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code, Part I - Safety Standard for Electrical Installations.

.2 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.

.3 CAN/CSA-C22.2 No. 38, Thermoset-Insulated Wires and Cables.

.4 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

.5 CAN/CSA-C22.2 No. 174, Cables and Cable Glands for use in Hazardous locations.

.6 CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.

.7 CAN/CSA-C22.2 No. 214, Communications Cables.

1.2 Submittals

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

2. PRODUCTS

2.1 Conduits

.1 See Electrical Specification 26 05 34 - Conduit, Conduit Fasteners, and Conduit Fittings – Electrical for general conduit requirements.

2.2 Wires in Conduit

.1 Wire: to CAN/CSA-C22.2 No. 38.

.2 Conductors:

.1 Size as indicated.

.2 Copper conductors.

.3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90.

.1 Insulation Voltage Rating:

.1 Circuits 120 V and less: 600 V.

.4 Wire Colour Coding:

.1 Utilize the following wire colours for the types of voltage/signals indicated:

.1 120 VAC Line: Black.

.2 120 VAC Control: Red.

.3 120 VAC Neutral: White.

.4 24 VDC Supply: Blue.

.5 24 VDC Control: Blue.

.6 24 VDC Common: Brown.

.7 4-20 mA Signal: White (+), Black (-).

.8 Protective Earth: Green.

.9 Signal Ground: Green/Yellow.

.10 Profibus: Red/Green.

2.3 TECK90 Multi-Conductor Cable

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene (XLPE), rated type RW90.

.1 Insulation Voltage Rating: 600 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: polyvinyl chloride material.

.7 Fastenings:

.1 One-hole aluminum straps to secure surface cables 50 mm and smaller. Two-hole aluminum straps for cables larger than 50 mm.

.2 Channel type or cable tray supports for two (2) or more cables.

.8 Cable Connectors / Fittings:

.1 Minimum requirements: Watertight, approved for TECK cable.

.2 Hazardous Locations:

.1 CSA approved.

.2 Watertight type with:

.1 An elastomeric bevelled bushing.

.2 A funnel entry, splined gland nut.

.3 A non-magnetic, stainless steel grounding device with dual grounding action.

.4 A taper threaded hub.

.5 A hexagonal body and gland nut.

.3 Integral seal type with metal-to-metal contact construction.

.4 Sealing of multi-conductor cable shall be accomplished with a liquid-type polyurethane compound.

.5 The fitting must:

.1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.

.2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding, or the explosion proof seal.

.6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.

.3 Approved products: Thomas & Betts Star® Teck XP series or approved equal.

2.4 ACIC/CIC Control Cable

.1 Cable: to CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.

.2 Conductors: copper, stranded, size as indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene(XLPE) rated type RW90.

.1 Voltage: As noted.

.4 Shielding as indicated on the Drawings:

.1 ISOS – Individually shielded pairs with overall shield.

.2 OS – Overall shield.

.5 Armour Type: Aluminum Interlocked.

.6 RoHS compliant.

.7 Fastenings:

.1 One-hole aluminum straps to secure surface cables 50 mm and smaller. Two-hole aluminum straps for cables larger than 50 mm.

.2 Channel type supports for two (2) or more cables at 1000 mm centres.

.3 Threaded rods: 6 mm dia. To support suspended channels.

.8 Cable Fittings:

.1 Minimum requirements: Watertight, approved for TECK cable.

.2 Hazardous Locations:

.1 CSA approved.

.2 Watertight type with:

.1 An elastomeric bevelled bushing.

.2 A funnel entry, splined gland nut.

.3 A non-magnetic, stainless steel grounding device with dual grounding action.

.4 A taper threaded hub.

.5 A hexagonal body and gland nut.

.3 Integral seal type with metal-to-metal contact construction.

.4 Sealing of multi-conductor cable shall be accomplished with a liquid-type polyurethane compound.

.5 The fitting must:

.1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.

.2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding, or the explosion proof seal.

.6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.

.3 Approved products: Thomas & Betts Star® Teck XP series or approved equal.

2.5 Ethernet Cable – Shielded, 300V Non-Armoured, Low-Bend Radius for Use Only in Automation Panels Patch Cords and Between Ganged Automation Panels

.1 Requirements:

.1 Cable: Industrial Grade Cat 6, 300V, Shielded, Ethernet cable.

.2 Shield Design: Overlapped aluminum-clad foil, sheathed in a braided screen of tin-plated copper wires.

.3 Conductors: 4 pair, 24 AWG, copper, solid.

.4 Insulation: Polypropylene.

.5 Operating temperature: 40°C to 85°C.

.6 Installation temperature: -40°C to 85°C.

.7 c(UL)us, CMG, RoHS compliant.

.8 Traction stress maximum: 100 N.

.9 Minimum bending radius: 24 mm single bend/40 mm multiple bends.

.10 Manufacturer: Siemens 6XV1878-2A or approved equal.

2.6 Ethernet Cable – Shielded, 600 V, Non-Armoured

.1 Requirements:

.1 Cable: Industrial Grade Cat 6, 600 V, Shielded.

.2 Shield Design: 100% coverage Foil Shielded.

.3 Conductors: four (4) pair, Bonded pair, 23 AWG, copper, solid.

.4 Insulation: Polypropylene.

.5 Operating temperature: -40°C to 75°C.

.6 Installation temperature: -25°C to 75°C.

.7 Flame test: CSA FT4.

.8 cUL, CMR, RoHS compliant.

.9 Traction stress maximum: 177.928 N.

.10 Minimum bending radius: 101.600 mm.

.11 Manufacturer: Belden 7953A or approved equal.

2.7 Ethernet Cable – Unshielded, 300 V, Armoured

.1 Requirements:

.1 Cable: Industrial Grade, Enhanced Cat 6 Cable, 300V, Solid, Unshielded, Aluminum Interlocked Armor.

.2 Conductors: 4 Pair, Bonded pair, 23 AWG, copper, solid.

.3 Conductor insulation: PO-Polyolefin.

.4 Outer jacket: Industrial Grade PVC.

.5 Temperature rating: -40°C to 75 °C.

.6 Flame test: CSA FT4.

.7 Approvals: CMG, CSA or equivalent.

.8 Manufacturer: Belden, 121872A or approved equal.

.9 Or approved equal.

2.8 Communication Cable – RS-485

.1 Requirements:

.1 Cable: RS-485, 1 Pr, 22AWG, Str TC, PE Ins.

.2 Impedance: 120Ohm.

.3 Voltage rating: 300V.

.4 Inner Jacet: PVC - Polyvinyl Chloride.

.5 Outer Jacet: PVC - Polyvinyl Chloride.

.6 Armor: SIA - Steel Interlock Armor.

.7 Inner shield: Bi-Laminate (Alum+Poly).

.8 Outer shield: Tinned Copper (TC).

.9 Insulation: Pair, PE - Polyethylene (Foam) and Conductor, PVC - Polyvinyl Chloride.

.10 Conductor: 22 AWG.

.2 Manufacturer:

.1 Belden 133106A.

.2 Or approved equal.

3. EXECUTION

3.1 General

.1 Do not splice cables. A continuous length is required for all feeds.

.2 Install in accordance with manufacturer's recommendations, observing requirements for minimum bending radius and pulling tensions.

.3 Exercise care in stripping insulation from wire. Do not nick conductors.

3.2 Installation of Wires in Conduit

.1 Install in conduit as per Section 26 05 34 - Conduits, Conduit Fasteners, and Conduit Fittings.

.2 Ensure conduit is dry and clean prior to pulling wire. If moisture is present, thoroughly dry conduits. Vacuum as required.

.3 Utilize wire-pulling lubricant.

3.3 Installation of TECK cable 0-600V

.1 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.

.2 Perform an insulation-resistance test on each conductor, prior to termination, utilizing a megohmmeter with a voltage output of 1000 volts DC. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 50 megaohms, or deviations between parallel conductors. Conductors with insulation resistance values, at one (1) minute, less than 25 megaohms, or that deviate from other similar conductors by more than 50% will be rejected.

3.4 Installation of Control Cables

.1 Install control cables in conduit or cable tray as indicated.

.2 Provide separation of cables from sources of noise, including other cables.

.1 For analog signals, provide separation distances as follows:

.1 120 VAC, 8 AWG and smaller: 100 mm.

.2 120 VAC, >8 AWG: 300 mm.

.3 600 VAC power: 300 mm.

.4 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.

.5 Medium Voltage: 450 mm.

.2 For control signals < 50 V, provide separation distances as follows:

.1 120 VAC, 8 AWG and smaller: 50 mm.

.2 120 VAC, >8 AWG: 300 mm.

.3 600 VAC power: 300 mm.

.4 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.

.5 Medium Voltage: 450 mm.

.3 For 120 VAC control signals, provide separation distances as follows:

.1 120 VAC, 8 AWG and smaller: none.

.2 120 VAC, >8 AWG: metal barrier or 150 mm.

.3 600 VAC power: metal barrier or 150 mm.

.4 VFD or other high harmonic cable: 150 mm in metallic conduit/300 mm other raceway.

.5 Medium Voltage: 450 mm.

.4 Advise the Contract Administrator if these separations cannot be achieved.

.3 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.

.4 Ground shields at one end only. Where possible, ground shields at the end where power is supplied to the cable. Utilize shield grounding bar in panels, where present, to ground overall shields. Individual pair shields to be grounded on appropriate terminals.

.5 Shield drain wires, at the ungrounded end, are to be taped back to the cable. Do not cut the shield drain wire off.

.6 CIC cable may not be installed in cable tray. Protection in conduit is required over the entire length.

.7 ACIC cable may be installed in cable tray, provided that:

.1 There is a barrier separating power and control cables within the tray, or

.2 The cable tray does not contain power cables, unless specifically authorized by the Contract Administrator in writing, and

.3 The ACIC cable voltage rating is equal or greater than the highest voltage contained in the cable tray.

3.5 Installation of Ethernet Copper Cables

.1 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.

.2 Provide separation of Ethernet cables from sources of noise, including other cables.

.1 Provide separation distances as follows:

.1 Instrumentation/Control < 50: 50 mm.

.2 120 VAC, 8 AWG and smaller: 100 mm.

.3 120 VAC, >8 AWG: 300 mm.

.4 600 VAC power: 300 mm.

.5 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.

.6 Medium Voltage: 450 mm.

.2 Advise the Contract Administrator if these separations cannot be achieved.

.3 Ethernet cables may be installed in cable tray, provided that:

.1 There is a barrier separating power and control cables within the tray, or

.2 The cable tray does not contain power cables, unless specifically authorized by the Contract Administrator in writing, and

.3 The cable voltage rating is equal to or greater than the highest voltage contained in the cable tray.

.4 Prior to placing an Ethernet copper network into service, perform Ethernet copper cable test utilizing an approved testing equipment and provide complete test results to the Contract Administrator for review.

.1 Submit product datasheets of proposed testing equipment to the Contract Administrator for review prior to performing the test.

.5 Provide a lightning protection device whenever copper Ethernet cables are routed outside.

3.6 Terminations and Splices

.1 Wire nuts are permitted only in the following circuits:

.1 Lighting circuits.

.2 Receptacle circuits.

.2 Exercise care in stripping insulation from wire. Do not nick conductors.

.3 Strictly follow manufacturer's instructions with regards to tool size and application methods of terminations and compounds.

.4 Where screw-type terminals are provided on equipment and instrumentation, terminate field wiring with insulated fork tongue terminals.

.5 Manufacturer: Thomas and Betts, Sta-Kon, or approved equal.

3.7 Reuse of Existing Wiring

.1 Except where specifically identified or approved, reuse of existing wiring is not permitted.

.2 Ensure all existing wiring is tagged prior to disconnection of equipment.

.3 Tag spare wires as “Spare” and indicate the location of the other end of the wire.

3.8 Installation in Conduit

.1 Utilize cable grips, appropriately selected to accommodate the type and geometry of the cable.

.2 Utilize cable pulling lubricant, compatible with the cable and conduit.

3.9 Cable Identification

.1 Install cable tags at both ends of cable.

3.10 Testing

.1 Perform an insulation resistance test on all new and existing power conductors that are being terminated as part of the Work.

.2 Perform TIA-568-C.2 for category 6 cabling and connecting hardware on all ethernet cables. The installation will not be considered complete if it fails any of the tests even if communication is occurring.

.3 Perform bus analysis and waveform capture of all Profibus network segments and verify that there are no errors. The PROFIBUS installation will not be considered complete if it has communication errors even if communication is occurring.

END OF SECTION

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Process and HVAC instrumentation.

1.2 References

.1 National Electrical Manufacturers Association (NEMA).

.2 Canadian Standards Association (CSA International).

.3 Canadian Electrical Code (CEC).

.4 Canadian Underwriters Laboratory, Inc. (cUL).

.5 National Pipe Thread (NPT).

.6 International Protection Code (IP).

1.3 Submittals

.1 Submit Shop Drawings and manufacturer's installation instructions.

.2 Manufacturer's Instructions:

.1 Include manufacturer's installation instructions for specified equipment and devices in operation and maintenance manuals.

2. PRODUCTS

2.1 General

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant.

.3 Operating conditions: 0-35°C with 5-95% RH (non-condensing) unless otherwise specified for indoor components.

.4 All outdoor instrument and equipment to be rated for -40 to 40°C.

.5 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

2.2 Outdoor/Indoor Temperature Element and Transmitter (Wall mount)

.1 Requirements:

.1 Sensor:

.1 3- wire RTD, Pt100.

.2 Probe length 120 mm.

.3 Probe diameter 6.25 mm.

.4 Measurement range: -200 to 850°C.

.5 Protective sheath for external mounting.

.2 Transmitter:

.1 Output signal: 4-20mA 2 wire with connection to HART.

.2 Accuracy: +/- 0.06°C.

.3 Enclosure:

.1 Transmitter is housed in a NEMA4X wall mount electrical enclosure with temperature element mounted externally.

.4 Operating Ambient Conditions:

.1 -40 to 85°C, 98% relative humidity with condensation.

.5 Approvals: CSA or equivalent.

.2 Acceptable Products:

.1 Siemens SITRANS TH300.

.2 This product was standardized by the City via RFP 449-2014.

2.3 Room Temperature Element and Transmitter

.1 Requirements:

.1 Sensor:

.1 Device box cover type 2- wire RTD, Pt100.

.2 Measurement range: 0 to 50°C.

.3 Stainless steel or Powder coated white steel.

.2 Transmitter:

.1 Output signal: 4-20mA 2 wire with connection to HART.

.2 Accuracy: +/- 0.06°C.

.3 Enclosure:

.1 Transmitter is housed in a NEMA4X electrical enclosure with temperature element mounted.

.4 Operating Ambient Conditions:

.1 -40 to 85°C, 98% relative humidity with condensation.

.5 Thermowell:

.1 Process Connection: 19 mm NPT(M) unless otherwise noted.

.2 Material: 316 stainless steel.

.3 Insertion Length: 89 mm minimum immersion.

.6 Approvals: CSA or equivalent.

.2 Acceptable Products:

.1 Siemens SITRANS TH300.

.2 Or approved equal in accordance with B7.

2.4 Horn

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Audible alarm.

.2 Performance:

.1 Temperature, Operating: -40 to+65°C.

.2 Sound Output Level: 100 dB nominal at 3 m.

.3 Features:

.1 Dimensions: 111 mm in height and width, and 63.5 mm in depth, for horn and enclosure.

.2 Diaphragm: Stainless steel.

.3 Projector: None, unless otherwise noted.

.4 Enclosure: Type: Corrosion resistant NEMA 4X.

.5 Voltage: 120 VAC, 60 Hz, unless otherwise noted.

.6 Current: less than 0.2 A.

.7 Manufacturers:

.1 Federal Signal 350WB.

.2 Or approved equal in accordance with B7.

2.5 Warning Light, Strobe

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Visual alarm.

.3 Type: Rotating reflector or flashing bulb.

.4 Provide means to synchronize flashes within corridors or rooms in the same field of view.

.2 Performance:

.1 Temperature, Operating: -37 to 87°C.

.2 Flash Rate: Minimum 80 per minute.

.3 Light Intensity: 800,000 candela or greater.

.3 Features:

.1 Dome Colour: Red, unless noted otherwise.

.2 Lamp Life: 60,000 hours minimum.

.3 Lamp: LED.

.4 Enclosure:

.1 Type: Corrosion resistant NEMA 4X.

.2 Mounting: Wall bracket, unless otherwise noted.

.3 Indoor/outdoor use.

.5 Voltage: 120 VAC, 60 Hz, unless otherwise noted.

.6 Current: less than 0.2 A.

.7 Manufacturer and model:

.1 Federal Signal SLM100.

.2 Or approved equal in accordance with B7.

2.6 Door Switch

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Monitor intrusion of standard door.

.3 Type: Magnetic, indoor use.

.4 Parts: Magnet on door, switch on door frame.

.2 Features:

.1 Type: Aluminum housing with 914 mm (36”) armored cable, unless otherwise noted.

.2 Gap Distance/Type: 76 mm (3”) Make.

.3 Signal Interface.

.1 Voltage: 24 VDC.

.2 Contact Type: SPDT.

.3 Contact Rating: 0.25 A @ 24 VDC.

.4 Connection: 914 mm (36”) lead wires.

.4 Manufacturer and model:

.1 GE Security 2507A.

.2 Or approved equal in accordance with B7.

2.7 Motion Detector

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Monitor occupancy.

.3 Type: Dual Technology Ultrasonic and Passive Infrared.

.2 Features:

.1 Type: plastic Casing.

.2 Coverage: 150 square meter (1600 square feet).

.3 Mounting: Mounting base provided.

.4 Operating temperature: 0° to 40°C

.5 Relative humidity: 0% to 95%.

.6 Power Requirements: Voltage: 24 VDC.

.3 Signal Interface.

.1 Voltage: 24 VDC.

.2 Contact Type: SPDT.

.3 Contact Rating: 500 mA @ 24 VDC.

.4 Manufacturer and model:

.1 Hubbell LODTRP.

.2 Or approved equal in accordance with B7.

2.8 Card Access Reader

.1 General:

.1 RFID Card Reader with 2.5”-4” range or better.

.2 -55C to 85C Operating temperature.

.3 Must be compatible with existing plant RFID card access system.

.4 Integrate new Card Readers with the existing Card access system. Work with the City to configure access.

.1 Electrical room shall only be accessible by the AICG and EI staff; all other rooms shall be accessible by all plant staff.

.5 Test and demonstrate to the Contract Administrator cards of different access levels and incorrect card types.

.2 Manufacturer and product line:

.1 HID multiCLASS SE RP40

3. EXECUTION

3.1 Installation

.1 Install equipment and components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturer’s recommended methods, procedures, and instructions.

.3 Support field-mounted panels, transmitters, and sensors on pipe stands or channel brackets.

.4 Electrical:

.1 Complete installation in accordance with Section 26 05 00 and Section 40 90 00.

.2 Install communication wiring in conduit or utilizing ACIC cabling if shown on the Drawings.

.1 Provide complete conduit/cable system to link instrumentation and the control panel(s).

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduit fill not to exceed 40%.

.4 Design Drawings do not show conduit layout.

3.2 Temperature Sensors

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Duct installations:

.1 Do not mount in dead air space.

.2 Locate within sensor vibration and velocity limits.

.3 Securely mount extended surface sensor used to sense average temperature.

.4 Thermally isolate elements from brackets and supports to respond to air temperature only.

.5 Support sensor element separately from coils or filter racks.

.4 Averaging duct type temperature sensors.

.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from the one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.

3.3 Identification

.1 Identify field devices with lamacoids. Install in a conspicuous location.

3.4 Testing and Commissioning

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 40 99 92 – Automation Testing and Commissioning.

3.5 Training

.1 Provide one (1) 4-hour training for instrument including but not limited to items listed in specification Section 40 91 01.

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide materials and fabrication of custom control panels as indicated and in compliance with Contract Documents.

.2 Panels shall incorporate controls and protection devices as shown on the Contract Documents.

.3 All panels shall be built by a CSA/cUL approved panel shop or manufacturer. Each panel shall bear the CSA/cUL seal with the manufacturer's file number.

.4 All new panels shall be factory assembled and pre-wired. Factory Acceptance Tests (FATs) and System Integration Functional Tests (SIFTs) as per Section 40 99 91 shall be performed and witnessed and accepted by the Contract Administrator prior to shipping any panels.

.5 Supply, install, wire and test all components inside the Control Panels according to the specifications herein and the Drawings.

.6 Any panels that are substantially modified from the original installation shall be inspected by an authorized CSA/cUL inspector and have a new CSA/cUL applied. Perform any required updated to substantially modified panels to meet the CSA/cUL requirements.

1.2 Submittals

.1 Submit the following in accordance with Section 01 33 00:

.1 For each component and material submit Shop Drawing which shall include:

.1 Schematic diagrams shall show the equipment serial or tag number, the City's drawing number, contract number, or similar identification which will indicate the particular equipment to which the diagrams apply. Diagrams shall show all equipment in the electrical system including internal wiring of subassemblies. Diagrams of subassemblies may be furnished on separate sheets.

.2 Wiring and interconnection diagrams shall show all wire connections to device terminals, terminal blocks, and all wiring within the panel. No more than two wires shall be shown connected to any one terminal. Terminals shall contain unique identifiers. All signals shall be able to be fully traced on the Drawings.

.3 Identify each device by a unique number or number-letter combination.

.4 Detailed IO module wiring diagrams.

.5 Detailed loop diagrams of connections to Field Device Panels, Termination Panels, Marshalling Panels, and HVAC Panels.

.6 Show spare contacts.

.7 Panel Layout drawings.

.8 Complete Bill of Materials.

.9 Configuration/parameter sheets including switch settings, parameter settings, and addresses. Show factory default settings and proposed settings.

.10 Diagram showing dip switches complete with proposed settings.

.2 Submit Shop Drawings for approval prior to panel fabrication.

.3 Keep updated red line drawings of each panel in each control room during area migrations.

.4 Provide as-built drawings at the end of the area migration of the panel including detailed IO module wiring diagrams, panel layouts, panel power distribution schematics, and detailed loop drawings.

.1 As-built drawings to adhere to the City of Winnipeg CAD Drafting Manual and the WWD CAD/GIS Standards.

1.3 Quality Assurance

1.4 Inspection

.1 Provide in accordance with Section 01 45 00 and as specified.

.2 A factory inspection of the control panels will be performed at the discretion of the Contract Administrator based upon the pre-shipment submittals.

.3 Demonstrate and test the control panel in the presence of the Contract Administrator designated representative as part of the FAT and SIFT.

1.5 Delivery, Storage and Handling

.1 Provide in accordance with Section 01 61 0 and as specified.

.2 Transportation method to site shall be in an air ride van or equivalent.

1.6 Equipment Identification

.1 Each Panel shall be tagged with lamacoid labels on the panel backboard where visible after wires are connected.

.2 Each panel shall have a CSA certification nameplate.

1.7 Warranty

.1 The Contractor shall warrant that all materials and equipment furnished under the Contract are in good working order, free from defects, and in conformance with system specifications. All installed equipment shall conform to the manufacturer’s official published specifications. The warranty shall begin at the system acceptance date and remain in effect for a period of one years from that date. The Contractor shall agree to repair, adjust, and/or replace (as determined by the Contract Administrator to be in its best interest) any defective equipment,

materials, or other parts of the system at the Contractor's sole cost. The City will incur no costs for service or replacement of parts during the warranty period of five (5) years. All third-party warranties shall be passed through from the Contractor to the City.

.2 The Contractor shall warrant and supply evidence that the installation of materials and hardware will be made in strict compliance with all applicable provisions of the Canadian Electrical Code.

.3 The Contractor shall warrant that the system and individual parts will function in accordance with the manufacturers' published technical description guide.

2. PRODUCTS

2.1 Manufacturers

.1 Devices of each function shall be of the same type and manufacturer.

2.2 Enclosures

.1 Design and test control enclosures in conformance with C22.2 Nº286. Enclosure types shall be as follows unless noted otherwise in the drawings or specifications:

.1 Indoor use, non process area: NEMA Type 12.

.2 Outdoor use or process area: NEMA Type 4.

.3 Corrosive and wet areas: NEMA Type 4X.

.2 The depth of the control enclosure or compartment shall be a minimum consistent with the maximum depth of the control devices plus the required electrical clearance. In no case shall the depth of the enclosure be less than 200 mm.

.3 Provide mounting panel for mounting of interior components. Panel finish shall be white enamel.

.4 Where heating from control devices results in a temperature rise which is detrimental to the contained equipment or its operation, provide louvers or forced air ventilation. Design ventilating openings to prevent the entrance of any deleterious substance. When forced air ventilation is required, the cabinets shall be pressurized. Air filters shall be of commercially available types and sizes.

.5 Provide a permanent metal data pocket attached to the inside of the enclosure. If space permits, the pocket shall be at least 250 mm wide and of depth and thickness to accommodate electrical diagrams.

.6 Enclosure construction shall be minimum 14 gage steel. Finish shall be white enamel inside and gray prime outside over phosphatized surface. Provide continuous hinges for enclosure doors with external screw clamps. Provide hasp and staples for padlocking.

Control panels shall be provided with heating, ventilation, and/or cooling as required to ensure the internal temperature and humidity are maintained at acceptable levels for the components within.

.1 Perform a heat-load analysis for all control panels containing heat-generating components. Determine if the thermal dissipation via the enclosure walls is sufficient or if additional cooling is required. If additional cooling is required, consider installing filtered louvers at opposite corners of the control panel to provide cooling through natural convection. If natural convection is insufficient, install a filtered fan unit to provide forced air flow through the panel.

.2 Where fans are provided on control panels, ensure that the fans positively pressurize the cabinet to prevent ingress of contaminants through small openings. The air used to positively pressurize the cabinets must be from a clean source.

.7 Manufacturer:

.1 Hoffman Proline enclosures.

.2 Or approved equivalent.

2.3 Components

.1 All components are to be DIN Rail Mounted.

.2 DIN Rail style TS 35 mm, slotted.

.1 When used to mount terminals, use straight risers such that the top of the terminals are at the same height as the wiring duct.

2.4 Control Wiring

.1 120-volt control wiring shall be Type MTW, THWN, or THHN. Conductors shall not be smaller than No. 14 AWG. Ampacity shall be in accordance with the CEC.

.2 Instrumentation signal cables shall be of the type used for field wiring.

.3 Wire and cable insulation shall be flame retardant.

.4 High flexible stranding type wire shall be used in restricted spaces or across hinged sections.

.5 Wire colour to follow the City of Winnipeg's Automation Design Guide, Electrical Design Guide, and Identification Design Guide.

2.5 Marking

.1 Identify wire terminations with a number to correspond with the schematic diagrams. Identification tags shall be preprinted white heat-shrinkable tubing, Raychem Thermofit TMS.

.2 Plainly and permanently identify control and power devices using the same identification as shown on the schematic diagrams. Show identification for devices inside the enclosure on a plate adjacent to, not on, the device.

2.6 Supply Circuit Disconnecting Means

.1 Provide a supply circuit disconnect for each control panel. Disconnect shall be a circuit breaker mounted within the control enclosure operated by a variable depth flange-mounted circuit breaker operating mechanism.

2.7 Wiring Methods

.1 Panel wiring shall be neatly contained in narrow-slot ventilated wireways, including incoming and outgoing field control wiring. Wireways shall be light gray coloured, restricted slot design, with matching snap-on covers. Use light blue coloured wireways for intrinsically safe wireways. Provide wireways with mounting holes and nylon "push" rivets for mounting. Wireways material shall be PVC or noryl.

.1 Size wireways such that they are not more than 40% full once the wiring is installed.

.2 Provide minimum 50 mm of clearance between wireway and wire terminations to allow for clear viewing of wire identification marking.

.3 Provide the mandatory ventilation clearances around heat-generating components as specified by the component manufacturer. Indicate mandatory component clearances on the panel layout drawings.

.4 Tie wiring run to control devices on the front door together at short intervals and secure to the inside front door with adhesive mounts. Mounts shall be adjustable releasable-clamp type for wire bundles 17 mm in diameter or smaller or releasable nylon cable ties for bundles larger than 17 mm in diameter. Attach mounts to front panel with adhesive.

.5 Provide a minimum of 19 mm separation between ventilated wireways containing intrinsically safe wiring and ventilated wireways containing non-intrinsically safe wiring.

.6 Categorize and group conductors based on their application. Provide separate wireways for conductors of each category in order to minimize electromagnetic interference. Categories 3 and 4 may be combined if space is limited.

.1 Category 1: AC Power and Control:

.1 AC Power for power supplies.

.2 120 VAC Control Wiring.

.3 24 VAC Control Wiring.

.2 Category 2: DC Power and Control:

.1 DC Power.

.2 DC Control Wiring.

.3 Category 3: Analog Signals:

.1 Analog I/O.

.4 Category 4: Communications:

.1 Communication Cables.

2.8 Terminal Blocks

.1 Provide enough terminal blocks for designed requirements including indicated spares. Wire all spare terminal blocks back to PLC or RIO cards.

.1 One terminal block shall be provided for each wire entering or exiting the control panel.

.2 No more than two wires shall terminate on the same terminal.

.2 Provide screw clamp compression terminals in style shown on drawing. Approved manufacturer:

.1 Phoenix Contact.

.3 Ground Terminals shall be electrically grounded to the mounted DIN rail.

.4 Provide fifteen (15) spare terminal blocks of each type for the project.

2.9 Ground Bar

.1 Provide Electric and Instrument Ground bus bars for each panel. Connect Electric and Instrument ground bus bars at circuit location nearest the panel external ground connection.

.2 Connect only instrument grounds to the Instrument Ground bus bar.

.3 Bus bars to have pre-tapped holes with screws. Size for 25% spare capacity, maximum one wire per screw.

2.10 Pushbuttons

.1 Schneider Type K or SK or approved equivalent.

2.11 Pilot Light

.1 Push to test.

.2 Schneider Type K or SK or approved equivalent.

2.12 PLC and RIOs

.1 See Specification Section 40 94 43.

2.13 Dual Ring Switches

.1 Provide dual ring switches for networked IO as shown on Automation-Cabinet Layout drawings.

.2 Modicon Extended Managed Switch 8TX (MCSESM083F23F1). No alternates or substitutes will be accepted.

.3 Provide all required hardware for a complete installation.

2.14 Relays

.1 Phoenix Contact PLC-RSC Series.

.2 Or approved equivalent.

2.15 Signal Conditioning Module

.1 Where required, provide signal conditioning modules which comply with the following requirements:

.1 Analog signal inputs: 4-20 mA DC into 500 ohms or less.

.2 Analog signal outputs: 4-20 mA DC into 500 ohms.

.3 Discrete output contacts: SPDT or DPDT rated 5A.

.4 Arrange electronic trips so that output contact opens in case of loss of signal or loss of power supply.

.5 Signal conditioning and isolating modules to be rated for continuous operation in an ambient temperature of 0 to 80°C. The ambient temperature effect on module accuracy is not to exceed + / -0.01% per °C within that range.

.6 Span and zero adjustments to be made by front accessible multi-turn potentiometers.

.7 Provide electronic trip modules with LED indicators for relay status.

.8 Signal conditioning modules to withstand 30 V per meter radio frequency radiation between 200 and 500 MHz with not more than 0.25% calibration effect. Provide modules with traps on the terminals to shunt conducted radio frequency interference to ground.

.9 Provide effective isolation of signal and power supply terminals from the case.

2.16 Power Supplies

.1 Provide all DC power supplies as required for all instrument circuits. Power all circuits from the local control panels or marshalling panels. Power supplies to be equal to Hammond or G.F.C., complete with an overvoltage protection module.

.2 Provide redundant configurations for power supply equipment serving more than one instrument loop, so that failure of a single unit will not disable all or any shared part of the instrumentation and communication system. Provide diode isolation for redundant direct current supply units and ground the negative terminal of the power supply.

.3 Unless otherwise required, all DC power supplies to be rated 24 VDC, adjustable ±20%, and set to provide 24 V on the panel direct current bus. Size the power supply for two times the connected load, minimum size is 2 amps.

2.17 UPS Power Supply

.1 Provide an online un-interruptible power supply (UPS) in each control panel that is not fed by an external UPS.

.2 UPS to provide the following inputs to the PLC:

.1 On Battery Status.

.2 Fault.

.3 Size UPS standby capacity for 60 minutes at full load rating. UPS size shall be no lower than shown on the Drawings.

.4 Provide on-line units, acceptable manufactures:

.1 Phoenix Contact,

.2 Toshiba,

.3 Or approved equal.

2.18 Lighting

.1 Provide lighting for all panels.

.2 Fixture mounting: top-centre of enclosure, unless otherwise noted.

.3 Lights: LED, white.

.4 Power supply: 24 VDC.

.5 Manufacturer:

.1 Hoffman.

.2 Or approved equivalent.

2.19 Spare Parts

.1 Provide ten (10) spare fuses for each panel of each rating type. Store in resealable plastic bag inside panel document holder.

3. EXECUTION

3.1 General

.1 Construct panels in conformance with C22.2 N^{o}286.

3.2 Wiring

.1 Wire panels as shown in the contract drawings and as per the Shop Drawing.

.2 All wires and cables inside the control panels shall be identified on both ends using permanent labels. Labels shall be machine printed; handwritten labels shall not be accepted. Utilize heat shrink labels where practicable.

.1 Wire labels shall match the Drawing labels.

.2 Wire terminations and connections shall match the Drawings and schematics.

.3 All individual conductors shall be labelled.

.3 No splices shall be used while wiring the panel.

3.3 Grounding

.1 All control panel components shall be adequately grounded in accordance with the component manufacturer's instructions, especially control system components.

.2 Bond all devices to the panel ground bus bar.

3.4 Terminals

.1 Jumper bars shall be used where possible instead of jumper wires.

3.5 Testing

.1 Test the control panel prior to the FAT. Provide a check list of the tests performed and results.

.2 Tests to include at a minimum:

.1 Power supply functionality.

.2 PLC and RIO processor and card functionality.

.3 Loop checks of all circuits.

.4 Relay and switch functionality.

.5 Receptacle and lighting functionality.

.6 All networking functionality.

3.6 Factory Acceptance Tests

.1 Perform Factory Acceptance Tests and System Integration Functionality Tests as specified in Section 40 99 91.

3.7 Inspection

.1 Inspect all panels after delivery to ensure no signs of damage from transportation. Inspect wires for loosened terminations.

.2 Notify the Contract Administrator and replace any component damaged in transportation.

3.8 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

NETWORK EQUIPMENT

1. GENERAL

1.1 Description

.1 Install and configure the extension of the control and supervisory network, please see the Automation Design Guide for further explanation of the different network functionality.

.2 Supply, install, and commission the new equipment as shown on the Drawings.

.3 All work provided on the network shall adhere to the requirements of the Automation Design Guide.

1.2 References

.1 Comply with latest edition of the codes and standards applicable and/or referenced in Section 40 90 00.

1.3 Submittals

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

.2 Submit updated network architecture drawings with tags and device configurations.

2. PRODUCTS

2.1 Ethernet Cables

.1 Provide for network connections as specified in Section 26 05 20.

2.2 Ethernet Patch Cables

.1 Requirements:

.1 Cat-6, shielded.

.2 Jacket Colour: Blue.

2.3 Ethernet Switch – Control and Supervisory Networks

.1 Requirements:

.1 Input voltage: 24 VDC, redundant dual inputs.

.2 Ethernet Ports:

.1 10/100/1000 BaseT(X), quantity as indicated on the Drawings.

.2 100/1000 BaseSFP, quantity as indicated on the Drawings.

.3 SFP modules:

.1 1000Base (1 Gigabit) SX, LC Connector, 0.5 km, minimum of four per switch, or as indicated on the Drawings.

.4 Console port: USB.

.5 Supported industrial protocols:

.1 PROFINET.

.2 EtherNet/IP.

.6 Management Protocols:

.1 RMON.

.2 RARP.

.3 DHCP Server/Client.

.4 DHCP Option 66/67/82.

.5 BootP.

.6 Syslog.

.7 LLDP.

.7 Security Protocols:

.1 HTTP.

.2 HTTPS.

.3 Telnet.

.4 SSH.

.8 Additional required supported protocols:

.1 IGMPv1/v2/v3.

.2 GMRP.

.3 GVRP.

.4 TFTP.

.5 SNTP.

.6 SMTP.

.7 SNMP Inform.

.8 SNMPv1/v2c/v3.

.9 IEEE 1588 PTPv2.

.10 IPv6.

.11 NTP Server/Client.

.9 Broadcast storm protection.

.10 Support for Port Trunking.

.11 Fanless design.

.12 DIN rail mount.

.13 Alarm relay dry contact: 1 A @ 24 VDC.

.14 IEEE 802.3x for Flow Control.

.15 Configuration via Web Browser.

.16 Operating temperature range: -10 to 60°C.

.17 Ambient Relative Humidity range: 5 to 95% (non-condensing).

.18 Enclosure: metal, IP30 protection.

.2 Manufacturer and Model:

.1 Moxa EDS-G512E-4GSFP with a minimum of four SFP-1GSXLC modules per switch.

.2 Moxa EDS-G516E-4GSFP with a minimum of four SFP-1GSXLC modules per switch.

.3 Or approved equal in accordance with B7.

.3 The use of Virtual Local Area Networks (VLANs) is not permitted.

2.4 Copper Ethernet Modular Patch Panel

.1 Requirements:

.1 Mounting: 35 mm DIN Rail mount, TS-35 “U” Rail.

.2 2 X Single Copper Module.

.3 Shielded Keystone RJ45 Cat 6 Connectors.

.4 Ports: As noted.

.5 Rated for Shielded Cat 6 wiring.

.2 Manufacturer and model:

.1 Belden MIPP-BD-CSD4 (as required).

.2 Or approved equal in accordance with B7.

3. EXECUTION

3.1 Network Configuration

.1 City of Winnipeg staff will determine IP address allocation and provide to the Contractor upon request.

.2 Network speed of 1Gb/s throughout the plant is required.

.3 Provide hardwired fault monitoring wired back to the local area PCS PLC for all network switches.

.4 Refer to the City's Automation Design Guide for an overview of each network.

3.2 General Installation

.1 Configure process control network equipment so as to create a correctly communicating installation.

.2 Ethernet installations shall be certified to Category 6 standards.

.3 Equipment shall be installed in panels by a CSA certified panel shop.

3.3 Time Synchronization

.1 Enable time synchronization using SNTP:

.1 Use 2048 as a default time interval unless a shorter time interval is required for switch specific functionality.

.2 Use the default gateway.

3.4 Testing

.1 Demonstrate communication on all networks with live data from installed equipment.

.2 Perform ping tests at variable packet sizes to demonstrate that the network speed and bandwidth meet the manufacturer's specifications.

.3 Perform, monitor, and record live disconnections of network links to demonstrate the network recovery performance per the communication protocol and manufacturer's specifications.

.4 The installation will not be considered complete if there are errors even if communication is occurring.

.5 Use latest IEEE 802 standards for testing.

END OF SECTION

1. GENERAL

1.1 Description

.1 Applications software is the software that provides functionality unique to this project, or that requires specific configuration from the standard software. All Applications software is to be developed or configured by the Contractor under this Contract.

.2 This Work includes:

.1 Adding the new UV system on the existing SCADA control network.

.2 It is important for the Integrator to have a strong understanding of the Wastewater industry and the process in each area of the plant. Review of contract documents, plant materials and existing logic will be required to gain the comprehensive understanding required to develop the Process Control System behaviour.

.3 Set-up, configure, and develop all programs, databases, environments for a fully operable system as described in the drawings, specifications, and appendices.

.4 Modify and tune the control loops and software interfaces to create a cohesive control system including:

.1 Proportional, Integral, and Derivative (PID) response parameters for control loops.

.2 Individual equipment performance.

.3 Data communication between processors, workstations, and servers.

.4 Operator workstation displays.

.5 Networking hardware configurations.

.6 PLC and HMI configurations.

.5 Provide temporary PLC programming as required during the testing and commissioning. Provide all updates to programming as required during the project to keep the NEWPCC plant functional for the operations staff to maintain the provincial license.

.3 The Contractor shall schedule the workshops specified in this section. Provide a minimum of three (3) weeks notice for a software design workshop.

.1 Integrate existing PLCs and vendor packages into the PCS.

.1 Provide all PLC programming on vendor, existing, and new PLCs to facilitate data exchange as required for the seamless integration of existing PLCs into the PCS. All monitoring, controlling, and alarming of existing PLCs shall be accessible from any PCS workstation after the integration.

.2 Replicate any vendor HMI screens using the new graphics developed by this project, or as provided by the City, in the PCS.

.2 Configure all network settings and configurations for reliable communication between the provided devices and the existing plant. Where redundant paths are installed, provide configuration to allow for automatic fail-over to the redundant network paths.

.4 All application software and configuration developed or modified under this Contract shall be owned by the City. The City may use this software for maintenance or development within NEWPCC or for other City Projects. The City may provide this application software to third parties to develop software on the City's behalf. All applicable intellectual property developed under this project shall be transferred to the City.

1.2 Software Design Workshops

.1 Location: Contractor's Trailer on Site.

.2 Objective: To allow for oversight and review of the Applications Software development.

.3 The Contractor shall prepare and distribute an agenda prior to the workshop.

.4 The Contractor shall collaborate with the City in the workshop.

.5 The Contractor shall take minutes and distribute the minutes within two (2) days of the workshop.

.6 Workshops:

.1 Configuration Workshop:

.1 Occurrence: Once at beginning of project.

.2 Scope: Contractor shall review all Application Software that will be used in the project and how they will interface. The schedule for software development will be reviewed. Requirements for software development submittals will be discussed.

.2 Standardized Logic Block Workshop:

.1 Occurrence: As required to demonstrate and review all standardized logic blocks as specified in Section 40 94 43.

.2 Scope: Review and demonstrate the standardized logic blocks. Workshop can combine multiple standardized logic blocks together.

.3 Standardized HMI Graphic Workshop:

.1 Occurrence: As required to demonstrate and review all standardized HMI graphics.

.2 Scope: Review and demonstrate the standardized HMI graphics including HMI layouts, equipment graphics, HMI navigation, user interface elements and trending. Workshop can combine multiple standardized HMI graphics together.

.4 Pre-Programming Workshop:

.1 Occurrence:

.1 Once after review of the PCNs and Vendor logic but before significant development has started on the PCS development for the area.

.2 Once per PLC to be integrated. After review of the PCNs and PLC logic but before significant development has started on the PCS development for the PLC Integration.

.2 Scope: Review the process area requirements and gather input from the operations and maintenance staff. Go over major control loops and how the logic will be implemented in the PCS. Review network interface maps affecting the area.

.5 Commissioning Area Workshop:

.1 Occurrence:

.1 Once per migration stage at the end of the PCS development for the area.

.2 Once per PLC integration at the end of the PCS development for the area.

.2 Scope: Review the commissioning plans for the area and proposed sequencing of commissioning within the area and associated schedule. Review and demonstrate the developed logic. Review and demonstrate the developed HMI Screens. Review required communication between the new equipment and the existing PCS before, during, and after commissioning. Review Operator control requirements and process downtimes during switchover. Review and demonstrate all required HMI functionality including alarming and trending. Demonstrate all functionality as requested by the Contract Administrator and City.

1.3 Submittals

.1 Submit the following in accordance with Section 01 33 00:

.1 Provide with Section 01 32 16.07 Construction Schedules an updated schedule based on software development.

.1 Every two (2) weeks at the construction meeting while the software is under development, a lead developer that is familiar with the state of the software development will attend and share their screen to review the progress made since the previous software review.

.1 Provide demonstrations of the software upon request.

.2 Provide software to Contract Administrator upon request.

.2 Shop Drawings:

.1 Outline of applications software to be developed.

.1 An overview description of each major software package and programming language or configuration method to be used for each different type of application.

.2 Schedule of each applications software.

.3 Standardized HMI Graphics:

.1 Submit documented copies of the standardized HMI graphics including screen layouts, HMI navigation, facility overview, active alarm page, historical events, trends, faceplates, process area and user interfaces.

.2 Documentation shall at a minimum include all details to understand the use of the graphic including:

.1 Description.

.2 Animation(s).

.3 Colour(s).

.4 HMI Faceplates:

.1 The faceplates shall be developed along side the standardized function blocks for seamless interfacing of the logic and faceplates.

.5 User Interactions.

.6 User Interaction Response.

.7 Trend Screens.

.8 Active Alarms.

.9 Historical Events.

.10 Headers and Footers.

.11 Dashboard.

.12 See the HMI Layout and Animation Plan in Appendix A for additional requirements.

.3 Demonstrate all HMI graphics.

.4 Software Design Submittal:

.1 Preliminary Design:

.1 Submit a HMI and PLC design criteria prior to initiating programming which includes:

.1 The general PLC function blocks derived from the PCN and existing (as applicable) PCS logic.

.2 The general PLC program structure.

.3 PLC memory map in broad categories (address ranges).

.4 The programming languages to be utilized.

.5 HMI Layout and animation criteria.

.2 25% Design:

.1 Submit a 25% complete submittal for each area, including Software Logic and HMI screens in pdf and native format.

.2 Include updated interface maps in excel and pdf format meeting the criteria of the automation design guide.

.3 The primary purpose of this submittal is to ensure that the methodology being utilized is as per requirements prior to bulk portion of work being completed. At this point, copies of code for similar pieces of equipment should not be completed.

.4 A plan for all HMI screens in the area including a rough layout shall be included. With at least 3 unique and distinct screens at 99% level of design. The three screens at 99% level of design shall not be copied and pasted of each other, similar trains, or of previous areas of the plant.

.5 The 25% Design submittal shall be resubmitted for review after incorporating all comments.

.3 99% Design:

.1 Submit a 99% complete submittal for each area a minimum of twenty (20) working days prior to the FAT, including:

.1 Complete software logic and HMI screens in pdf and native format.

.2 PLC database and HMI interface data map in excel and pdf format.

.3 Third party interface list in excel and pdf format.

.4 FAT and SIFT procedure (see Section 40 99 91, FAT and SIFT Procedures for requirements).

1.4 Quality Assurance

.1 Provide in accordance with Section 01 45 00 and as specified.

1.5 Delivery, Storage and Handling

.1 Provide in accordance with Section 01 61 00 and as specified.

1.6 Warranty

.1 The Contractor shall warrant that all materials and equipment furnished under the Contract are in good working order, free from defects, and in conformance with system specifications. All installed equipment shall conform to the manufacturer's official published specifications. The warranty shall begin at the system acceptance date and remain in effect for a period of one years from that date. The Contractor shall agree to repair, adjust, and/or replace (as determined by the Contract Administrator to be in its best interest) any defective equipment, materials, or other parts of the system at the Contractor's sole cost. The City will incur no costs for service or replacement of parts during the warranty period of one (1) year. All third party warranties shall be passed through from the Contractor to the City.

.2 The Contractor shall warrant that all application software developed for the project shall be free from defects leading to unintended operation of the plant equipment. The application software will be based on the Process Control System requirements and the existing DCS functionality to replicate the existing control system. The warranty shall begin at the system acceptance date and remain in effect for a period of one years from that date. The Contractor shall agree to repair or adjust the application software if defects are found. The Contractor shall expedite the repair or adjustments to the level of severity to ensure no additional damages occur to the plant, personnel, or treatment capacity occur. All repairs or adjustments will not take longer than one (1) calendar month to complete from the time of notice.

.1 The system acceptance date is unique for each stage in the migration plan and covers the work developed in that stage.

.3 The Contractor shall warrant that the system will function in accordance with the manufacturer's published technical description guide.

.4 The City may make documented and tracked changes to add or modify logic based on operational requirements or self-correct any issues instead of making warranty claims. These adjustments to the program will not impact the warranty, and the new item to each program is not covered under the warranty.

2. PRODUCTS

2.1 PLC Software Development

.1 EcoStruxure Control Expert shall be used to develop all PLC software. The Contractor shall maintain their own license for software development throughout the project duration.

2.2 SCADA Set-up

.1 Plant SCADA Project:

.1 Cluster Name: NEWPCC.

.2 System wide parameters shall be defined in the Parameters section under Set-up.

.3 Parameters specific to a group of Servers or clients shall be defined in profile except where parameters are required to be defined in the local .ini file.

.4 Parameters specific to an individual machine shall be defined in local .ini.

.2 All alarms shall be recorded with the accurate synchronized time.

2.3 PLC Program Requirements

.1 The PLC system will provide all functionality including:

.1 Manual controls.

.2 Automatic controls.

.3 Alarm annunciation.

.4 Continuous control loops.

.5 Redundancy.

.2 Refer to the Automation Design Guide for PLC Programming Requirements.

.3 Additional requirements for PLC and PLC program in Section 40 94 43.

.4 PLCs shall be programmed with Function Blocks.

.5 All process control shall be implemented on the PLC.

.1 No HMI logic shall control the process.

.2 PLC function shall remain undisturbed if connection to the HMI lost.

.6 Format Function Block layouts into sheets the size of 11 x 17 inch paper for ease of printing. Group Function Blocks by logical control groups. Use landscape sheet orientation.

.7 Break PLC program into sections based on control loops or parallel process trains.

.8 Break PLC program sections into subsections based on individual equipment operation.

.9 Do not use indirect addressing and non-visible data links.

.10 All timer settings, set points, and miscellaneous adjustments will be determined during application software development or plant start up. All settings and adjustments shall be easily made through the programming software.

.11 Unless otherwise indicated, reset and start running all strategies following a power interruption. Software signal selectors and mode memories which are toggled or advanced by momentary signals, are required to retain their last setting through power outages, except as indicated otherwise.

.12 Logic outputs of function blocks shall only access Inputs and Outputs:

.1 Accessing function block's public variables are not allowed.

.13 All function blocks shall be connected by visible Link. Where this is unable to be achieved, this shall be thoroughly documented in a manner that it cannot be missed. This documentation

shall be consistent throughout the project. Documentation of non-visible links to be approved by the Contract Administrator on a case by case basis.

.14 Limit cross over links to avoid clutter in the code. Simplify links as much as possible for ease of reading and maintenance.

.15 All Bool variables shall be named based on the variable when the value is 1 being true.

.16 Function Blocks shall be connected/placed in a way to minimize execution and propogation delay.

.17 Documentation:

.1 Overall process description, include relevant description on associated sheets.

.2 Hyperlinks to allow for clicking and following of signals.

.3 Physical hardware arrangement notes including equipment tags and IO cards in use.

.4 Signal names.

.5 Communication parameters and signals.

.6 Animation Table.

.7 Associated HMI screens.

2.4 HMI Software Requirements

.1 Existing HMI Server Software to tie into:

.1 I/O server.

.2 Report server.

.3 Alarm server.

.4 Trend Server.

.5 OPC Server.

.6 Modbus Driver.

.7 DNP3 Driver.

.8 Ethernet IP Driver.

.2 Manufacturer and Model:

.1 Aveva Plant SCADA.

.2 This product was standardized by the City via RFP 756-2013. No alternates or substitutes will be accepted. Provide licenses as required throughout the project duration.

.3 General:

.1 The Contractor shall develop the HMI design to allow for monitoring and control of the plant. HMI screens and layouts will be based on the existing P&ID drawings as a guide. Refer to the City's HMI Layout and Animation Plan for requirements and guidelines for PCS screen development.

.1 If there is a discrepancy between the P&IDs and the HMI Layout and Animation Plan, submit an RFI to the Contract Administrator for guidance, clearly show the discrepancy using visuals where needed.

.2 Provide navigation such that from the main screen:

.1 Any process area can be reached in one click of the mouse.

.2 Any control loop can be reached in two clicks of the mouse.

.3 Any individual device can be reached in three clicks of the mouse.

.3 Provide area to area navigation elements to allow for complete circular navigation through all process areas at the process area level.

.4 Maintain consistent graphics throughout the project.

.5 Maintain consistent layouts throughout the project.

.6 Layout the screens to best depict the actual process occurring while maintaining readability.

.7 Develop Event Journal for operator actions, the following will be included but not limited to journal log, user logon, time, change of process values, setpoints, and digital signals status change. The journal to log show current values to new values.

.8 Develop help screens and onscreen directions to provide additional information to help the operations staff understand the control options where complex operations are required.

.9 Where possible, design overview displays similar to the physical layout of the facility. The perspective to the physical layout should be from the local main control room.

.10 Provide operators access to all current setpoints available on the PCS. Limit set point ranges to reasonable limits for the process and as per vendors or manufacturer's equipment limits. Ensure setpoint permissions for Operators, the City's AICG, and the EI group are maintained.

.11 Display all monitored values. Graphic context shall update based on measured values.

.4 Loss of Communication Sensing by the control system:

.1 Monitor the health of each PLC at the plant including vendor supplied PLCs which are on the Control Network by directly monitoring the PLC systems' words. Display their various status parameters such as low battery, Primary/Secondary, Running/Not Running, and communications (normal/fail) conditions.

.2 Generate alarm if communication with the hot PLC fails or the hot PLC is not running for 60 seconds.

.5 PLC hardware alarms that are available from the PLC's system words shall be read by Plant SCADA directly from the PLC's system words without the use of intermediate PLC logic.

3. EXECUTION

3.1 Testing

.1 Refer to Section 40 99 91 and Section 40 99 92 for FAT, SIFT, SAT and SIT procedures.

3.2 Tuning

.1 Attain optimum system response and performance by tuning hardware and software components. Include the following:

.1 Poll block frequency and phasing.

.2 Point scan frequency.

.3 Trend scan frequency.

.4 Modbus RTU/TCP, LAN.

.5 Page change linkage.

.6 Plant Monitoring, Reporting and Data Logging.

.7 Regrouping of PLC points and files to optimize the quantity of blocks transmitted to process computers.

.8 Elimination of network transmission errors and time-out occurrences.

.2 Optimize PLC, PC, and network software to impose minimum loads on the equipment, with the following priorities:

.1 Minimal network traffic.

.2 PC processing.

.3 PLC processing.

.4 Network processing.

3.3 Reports

.1 The City may add and commission reports as Operations requires in areas handed over to the City.

.2 The City may directly connect to PLCs for data reporting requires in areas handed over to the City.

3.4 Vendor PLC Integration

.1 Integrate the vendor PLCs identified in the migration plan into the main PCS.

.2 Include all screens into the main PCS and add the available alarms, IO points, and navigation to create a seamless transition when interfacing with the vendor PLC equipment.

.3 Commission all functionality and interfaces of the vendor PLCs to show the functionality is maintained.

3.5 Software Copies

.1 Use and keep up to date version control application to save and track the program versions and the schedule of when each version is active in the plant. Provide the version control schedule and any historical application versions upon request of the Contract Administrator.

.2 Integrator to provide copies of all applications software to the Contract Administrator at beginning of switchover.

.1 Provides live copies daily to the Contract Administrator during the switchover for each day that the applications are modified.

3.6 Software Repairs

.1 When on-site commissioning and integration has begun, supply continuous services to effect start up, fine tuning, and removal of deficiencies in the software or data. Complete the integration and repairs within one (1) month or less. If at the end of one (1) month the software is not completely correct, then repair services may be provided by the Contract Administrator or an agent designated by the City and the actual cost incurred may be deducted from the Lump Sum Contract Price.

3.7 Training

.1 Film and record screens of at least one (1) occurrence of each training type. Edit videos to show relevant information with overlays as required, remove any distracting contents. Edit videos to be concise. Submit training videos for review. Provide City with copies of each training video on USB.

.2 Training timing to be coordinated with the Contract Administrator.

.3 Management Seminar:

.1 Occurrence: Once.

.2 Length: Two (2) hours.

.3 Location: NEWPCC.

.4 Objective: Walk through of new systems. Provide high level understanding of application software for monitoring and controls. Demonstrate how to generate custom reports and trends.

.4 Operations Training:

.1 Occurrence: Four (4) times.

.2 Length: Half Day.

.3 Objective: Walk through new system. Demonstrate each type of control loop. Review each process area in depth demonstrating typical operation of each area. Respond to questions as required. Review of new alarm management system. Provide all training required to operate PCS systems. Make time available for questions and provide answers.

.4 Training must occur before handing area over to City for operation.

.5 Electrical and Instrumentation Maintenance Training:

.1 Occurrence: Three (3) times.

.2 Length: Half days.

.3 Objective: Walk through new hardware installed. Review drawings and how information is presented. Visit each new panel and show the installation and additional field wiring added. Provide all training required to troubleshoot and fix hardware or wiring issues.

.6 Software Maintenance Training:

.1 Occurrence: Two (2) times.

.2 Length: Half day.

.3 Objective: Review new systems. Review programming methodology. Review standardized logic and HMI graphics. Run a full day tutorial on creating a new compound control loop using the standardized blocks and HMI graphics in a style that matches existing system. Review in detail the PLC control logic and documentation for each area.

3.8 City Access

.1 To facilitate and maintain the plants treatment capabilities, the City shall have super user administrative access to all live system component at all time. Submit system administrative user accounts and passwords in sealed envelopment to City with in five (5) business days of creation or change.

.1 A Field Instruction will be provided to the Integrator each incident the City is required to modifying the working applications to maintain plant functionality.

.2 The Integrator may maintain the City's changes or can implement their own correction.

3.9 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide all testing and commissioning for all Process Control System (PCS) and automation components necessary to confirm the functional performance for the equipment and systems, include complete commissioning and demonstration of the new work integrated and working on the existing PCS.

.2 Perform a Site Acceptance Test (SAT) at site prior to commissioning to demonstrate that the installation satisfies the project installation requirements and applicable codes and standards.

.3 Perform a Site Integration Test (SIT) at site to demonstrate that all the control system components are fully integrated and working together as specified in the project documents as required for complete PCS functionality.

.4 Testing is performed to:

.1 Demonstrate and document that the entire PCS is operating in accordance with the design requirements;

.2 Contribute to the safe and reliable operation of the plant; and

.3 Provide a baseline result for routine maintenance of system and related components.

1.2 Submittals

.1 Submit the following in accordance with Section 01 33 00.

.2 Submit SAT plans and schedules a minimum of two (2) months prior to testing.

.3 Submit commissioning plans and schedules a minimum of two (2) months prior to testing.

.4 SAT Plan:

.1 Contractor shall submit the SAT plan for Contract Administrator review and acceptance.

.2 The SAT plan provided by Contractor shall include:

.1 Scope of the test, including hardware, software, programming, configuration, documentation etc.

.2 Hardware, including construction, visual inspection, wiring, labeling, agreement with shop drawing requirements and acceptance criteria.

.3 Software, including the loaded application and HMI software and the configuration.

.4 Hardware and software configurations shall comply with the FAT and SIFT results.

.5 FAT and SIFT functional tests to be re-performed after installation.

.6 Tests that were not completed during the FAT/SIFT and any open FAT/SIFT punch list item.

.7 Tests to be performed after loop checks such as interlock, logic and sequence check.

.8 Security of all installed equipment on the PCS networks and subnetworks (fire wall rules and network segmentation).

.5 SIT Plan:

.1 Contractor shall submit the SIT plan for Contract Administrator approval.

.2 The SIT plan provided by Contractor shall include:

.1 Scope of the test, including hardware, software, programming, configuration, documentation etc.

.2 Tests to confirm interoperability of systems involved.

.3 Any functional test to be re-performed after interface to package control system.

.6 Supplement submittal documentation as needed to provide adequate records of testing and commissioning activities in accordance with accepted industry practice.

.7 Issue submittals for Contract Administrator review and acceptance in accordance with the project schedule as defined herein and in a timely manner to ensure that all required documentation is in place prior to the commencement of any testing or commissioning activities.

.8 Coordinate the submittals detailed in other sections of the specifications with the requirements defined in this section to achieve a complete set of documentation without overlap or gaps.

2. PRODUCTS

2.1 Testing Equipment

.1 Typical test equipment to perform test, configuration, calibration and loop checks include but are not limited to:

.1 Digital multimeter.

.2 Portable pressure calibrator.

.3 Dead weight tester.

.4 Precision pressure gauge.

.5 Temperature calibrator.

.6 Temperature calibration bath.

.7 Standard temperature sensor and meter.

.8 Loop calibrator.

.9 Hand-held oscilloscope.

.10 Ethernet fiber and copper network tester.

.11 Profibus PA and DP segment tester.

.12 Profibus PA hand-held field communicator.

.13 HART hand-held field communicator if applicable.

.14 Two way radio.

2.2 Testing Equipment Calibration

.1 Contractor shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

.2 The firm providing calibration services shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.

.3 Instruments shall be calibrated in accordance with the following frequency schedule:

.1 Field instruments analog and digital: twelve (12) months maximum;

.2 Laboratory instruments: twelve (12) months maximum;

.3 Leased specialty instruments: twelve (12) month maximum.

.4 Dated calibration labels shall be visible on all test equipment.

.5 Calibrating standard shall be of better accuracy than that of the instrument tested.

3. EXECUTION

3.1 General

.1 The testing and commissioning activities described herein applies to all components and systems that make up the entire Process Control System for the work provided under this project.

.2 All test reports shall include:

.1 The date.

.2 The name, title, and company of the personnel performing the test. Document any required qualifications held.

.3 The conditions during the test as applicable (weather, process conditions, etc.)

.4 The name, title, and company of the representative observing the test.

3.2 Qualification of Personnel

.1 The personnel performing the field tests and commissioning shall be experienced and thoroughly familiar with the apparatus and systems being tested and commissioned. They shall be capable of conducting the tests and commissioning activities in a safe manner, analyze the test data and make a decision on operability of specific equipment and system.

.2 The Contract Administrator shall witness the testing and commissioning.

.3 City of Winnipeg representatives shall observe the testing and commissioning.

3.3 Commissioning Preparation

.1 Carry out all testing and pre-commissioning activities as required herein.

.2 Coordinate all pre-commissioning schedules with the Contract Administrator.

.3 Keep accurate records of all works completed and submit final documentation for each pre-commissioning activity as and when completed for each portion of the project. Certify all final submissions as accurate and true.

.4 Review FAT and working copies of the construction documents to verify the condition is acceptable and suitable for commissioning.

.5 Prepare Commissioning Plan.

.6 Submit Commissioning Plan for review and approval by Contract Administrator.

.7 Coordination and schedule and manufacturer’s assistance as required.

.8 Provide any manufacturer’s instructions in the commissioning plans.

.9 Loop Checks:

.1 Perform loop checks to verify proper operation of all loops prior to commissioning.

.2 Check Documentation.

.3 Visually inspect the installation.

.4 Verify the loop functionality.

.10 Instrument system tests:

.1 Demonstration of operation of all equipment in all control modes as documented in the Process Control Narratives.

.11 SAT:

.1 Perform the SAT to demonstrate proper functionality of the system at final installation.

.2 Check of Hardware/Software inventory;

.3 Mechanical inspection;

.4 Wiring and termination inspection;

.5 System energization;

.6 Checking hardware redundancy and diagnostic;

.7 Checking operator interface;

.8 I/O test;

.9 Verification of the device network interfaces;

.10 Function check; and

.11 Performing the tests which could not be completed during the FAT.

.12 SIT:

.1 Perform the SIT to demonstrate the functionality and compatibility of all interconnected systems at final installation to achieve the Process Control System required performance The SIT consists of testing the communication and interaction between the PCS sub-systems or with other systems, such as mechanical package control systems, to ensure desired functional performance. The SIT shall be performed after the SAT for each system/sub-system has been successfully completed.

.2 Mechanical inspection;

.3 Testing communication links;

.4 Checking operator interface;

.5 Testing Hardwired I/O;

.6 Functional tests; and

.7 Performing the tests that could not be completed during the SIFT.

.13 Produce test reports for all performed tests and results and provide in the O&M Manuals.

3.4 Commissioning

.1 Carry out all testing and commissioning activities as required herein.

.2 Coordinate all commissioning schedules with the Contract Administrator.

.3 Keep accurate records of all works completed and submit final documentation for each commissioning activity as and when completed for each portion of the project. Certify all final submissions as accurate and true.

.4 Reviewing commissioning plan;

.5 Reviewing pre-commissioning reports to verify acceptable condition for commissioning phase;

.6 Perform Loop Functional Checks;

.1 See Appendix L for loop check test form templates.

.2 Demonstrate equipment functionality as described in the Commissioning Plan. Minimum requirements shall demonstrate all functionality in the Process Control Narratives and specifications.

.3 For analog signals use 4-20 mA sources to simulate the transmitter signal. For Profibus instruments, use a handheld communicator connected at the transmitter to simulate the signal. For discrete signals, simulation includes the use of a jumper or lifting a wire/opening a fuse in the circuit.

.4 Simulate values at multiple points (in both increasing and decreasing directions) of transmitter span (0, 25, 50, 75 and 100%) to confirm the sensor/transmitter, HMI and any other indicators all agree.

.5 Simulate values above and below range to confirm failure reaction in PCS. Simulate a sensor/transmitter failure and/or disconnection to verify the failure reaction in PCS.

.6 Reconnect the transmitter to verify the device is automatically and correctly communicating with PCS. Final alarm and control set point adjustments as necessary;

.7 Interlock Verification:

.1 Force each interlock initiator, one at a time, and confirming that all interlock actions occur at the proper trip points in accordance with the Process Control Narratives.

.8 Sequence Logic Check:

.1 Demonstrate all sequence logic and control loops as described in the Process Control Narrative. Force each sequence logic or control loop initiator, one at a time, and confirming that all logic actions occur properly in accordance with the Process Control Narrative.

.9 Adjustments of controller's PID value (Loop Tuning) as necessary;

.10 Verification of complex control schemes;

.11 Demonstrate and monitor PCS diagnostic alarms;

.12 Monitor the control system performance for any system failures during testing and operation. System failures include but are not limited to server errors and warnings, and network health;

.13 Commissioning of analyzers, sample handling systems and other special instruments;

.14 Create a Commissioning report upon completion of all commissioning activities demonstrating and verifying all functionality as laid out in the commissioning plan. Include tests and demonstrations performed, measured values, system response, and tuned values.

.1 Submit Commissioning Report for Contract Administrator's review and acceptance.

3.5 Contractor Representative

.1 Designate and furnish one or more Contactor personnel to coordinate and expedite all testing and commissioning activities and documentation functions.

.2 Contractor representative(s) to coordinate all testing and commissioning works carried out by specific equipment vendors in accordance with the commissioning planning and schedules submitted by the Contractor.

.3 Representative(s) to attend all meetings concerning the commissioning function as may be requested by the Contract Administrator. Representative(s) to be available at all times during the testing, pre-commissioning, commissioning and performance evaluation phases of the project.

3.6 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

MAINTENANCE AND SUPPORT

1. GENERAL

1.1 Maintenance Services

.1 Maintain equipment per manufacturer's recommendations up to the final completion of the construction.

1.2 Support Services

.1 Duration:

.1 The duration of support services is to extend during the warranty period (one (1) year past Total Performance).

.2 Requirements:

.1 Provide telephone support for all products supplied (during regular business hours).

.2 Respond to emergency service calls (during regular business hours).

.3 Telephone Support:

.1 Telephone support to utilize service personnel knowledgeable in the products and have the required troubleshooting skills.

.2 No payment will be made for telephone support during the warranty period.

.4 Emergency Service Calls:

.1 Respond to service calls from the City when the system is not functioning correctly.

.2 Qualified control personnel to be available to provide on-site service upon a critical failure, whenever required.

.1 A critical failure is the inability to operate of any part of the critical system supplied or modified by the Contractor.

.2 Critical systems include, but are not limited to:

.1 Communication networks.

.2 MCC.

.3 PLC and RIO systems.

.3 Perform work continuously until system is restored to a reliable operating condition.

.4 Response Time:

.1 The response time to emergency service calls is to be less than four (4) hours.

.5 Record each service call request, when received separately and include:

.1 Serial number identifying component involved.

.2 Location, date, and time call received.

.3 Nature of trouble.

.4 Names of personnel assigned.

.5 Instructions of work to be done.

.6 Amount and nature of materials used.

.7 Time and date work started.

.8 Time and date of completion.

.6 Costs:

.1 If the issue is determined to be due to poor workmanship or defect of the Contractor, no payment will be made to the Contractor.

.2 If the issue is determined to be due to failure of a physical component supplied and is covered under manufacturer's warranty, no payment will be made to the Contractor.

.3 If the issue is determined to be due to an issue outside of the Contractor's responsibility, the Contractor will not be paid for the service call to the Site (or for estimating the required work), but will be paid a mutually agreed upon value to correct the issue, at the discretion of the City.

2. PRODUCTS (NOT APPLICABLE)

3. EXECUTION (NOT APPLICABLE)

END OF SECTION

1. GENERAL

1.1 Scope

.1 Supply and install three (3) complete 1000 kg capacity under running monorail hoist systems over the UV channels (one (1) over each channel). Any other requirements not set forth in these specifications, but necessary for the safe and reliable operation of the equipment, shall be included.

.2 Supply and install three (3) complete 2268 kg capacity overhead under running monorail fall arrest trolley system over the UV channels (one (1) over each channel). Any other requirements not set forth in these specifications, but necessary for the safe and reliable operation of the equipment, shall be included.

.3 Contractor and crane supplier will furnish on this order:

.1 All material necessary for complete installation of the above-mentioned cranes including runway beams, hangers and clamps.

.2 Complete controls.

.3 Equipment operating instructions.

.4 Drawings and parts lists as specified.

.4 Contractor and crane supplier will furnish the materials and labour for the following:

.1 Complete erection.

.2 Steel runway beams.

.3 Electric power service.

1.2 References, Codes and Standards

.1 The complete system, including the installation, must conform to the applicable requirements of the latest edition of the following:

.1 CSA B167 – Overhead travelling cranes – Design, inspection, testing, maintenance, and safe operation.

.2 CSA Z259.2.2 – Self-retracting devices.

.3 ANSI Z359 – Fall Protection and Fall Restraint.

.4 ASME Standard B30.16 Overhead Hoists – Underslung.

.5 ASME Standard B30.17 Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist).

.6 ASME Standard B30.10 Hooks.

.7 HST-4M .Performance Standard for Overhead Electric Wire Rope Hoists.

.8 Occupational Safety and Health Administration (OSHA) – Specification 1910.179: Overhead and Gantry Cranes OSHA and Provincial requirements.

.9 OSHA 1910:140.

.10 OSHA 1926.502.

.11 Hoist Manufacturers Institute (HMI).

1.3 Submittals

.1 Submit product brochures.

.2 Submit Shop Drawings including full product specifications, performance and regular maintenance schedules.

.1 Manufacturer’s name and catalogue number of any equipment to be furnished not manufactured by vendor.

.2 Any exception or difference of any equipment to be furnished from that specified and reason for the substitution.

.3 Name and address of manufacturer’s representative nearest the project site maintaining 24-hour service facilities and complete stock of spare parts.

.4 Supply spare parts as required for one year's maintenance.

.3 Installation, operation, maintenance and lubrication manuals.

1.4 Qualifications

.1 Supplier, and Installing Contractor, and its personnel shall have a minimum five (5) years of demonstrated experience in the related field of design, fabrication, installation, testing and commissioning of this type of equipment.

.2 Acceptable Suppliers:

.1 Century Cranes.

.2 Kone Cranes.

.3 Acculift.

.4 Pydee Engineering.

.5 Approved equivalent.

1.5 Quality Assurance

.1 Products shall be from a manufacturer that has been regularly engaged in the design and manufacture of the product for over ten (10) years, with a continuous representation for sales and service in the province of Manitoba for at least five (5) years.

1.6 Design Requirements

.1 Design hoists/cranes systems in accordance with the applicable standards and codes.

.2 The equipment will be operated in ambient temperatures ranging from 5°C to 30°C.

.3 Design hoist/crane systems to be capable of lifting its full rated capacity at any location along the crane bridge, and runway beam.

.4 Hoist/crane systems shall be designed to fit within the space allocated on the Drawings.

.5 Cranes shall remain operational under the following conditions:

.1 Vertical deflection of monorail beams under crane loads: L/600 (L: span).

.2 Lateral deflection of monorail runway beams under lifting loads: L/600 (L: span).

.6 Hoist shall be capable of lifting its full rated capacity from the floor level to the clear hook height.

.7 Electrical classification: NEMA 4X.

.8 Electrical certification: CSA / cUL.

.9 Electrical power characteristics: Power for operating the equipment will be supplied by a 575 V, 3 Phase, 60 hertz circuit.

.10 Type of Control:

.1 Pendant type push button.

.11 Size of girder beams shall be specified and supplied by crane supplier.

2. PRODUCTS

2.1 Power Driven Trolleys

.1 Three (3) required.

.2 Underslung, four wheel.

.3 Geared, power operated drive, electric break, shock free on starting and stopping.

.4 Suspension systems to match hoists:

.1 Regular Hook Suspension Type:

.1 Three (3) required: WLL: 1,000 kg.

.5 Adjustable width – to suit monorail beams.

.6 Steel universal tread flanged hardened wheels with permanently lubricated shielded ball bearings.

.7 Drop stops in event of wheel failure.

.8 Steel side plates and connector pin.

.9 Hoist suspension plate for hook mounted hoist.

.10 Acceptable product: CM or approved equivalent.

2.2 Powered Hoists

.1 Three (3) Required

.2 Top hook mount:

.1 Three (3) units: WLL: 1,000 kg.

.3 A low head room hoisting machine of proper capacity shall be mounted on the trolley. It shall consist of a motor, gear reducer, hoist drum, sheaves, load block, hook, and hoisting rope. An electric brake shall be supplied on the hoist.

.4 The motor shall be designed specifically for hoisting duty. The electric brake shall be of suitable size to promptly stop the motor rotation in either direction, and hold the load.

.5 Precision cut, full depth teeth, heat-treated forged steel gears shall be used in the gear reducer. These gears shall be provided with oil bath lubrication and enclosed in a drip proof case.

.6 The hoist drum and sheaves shall be of large diameter to permit maximum rope life. The drum diameter shall be at least 20 times the rope diameter and shall be grooved to provide for the entire lift without overlapping the rope. The drum flanges shall be guarded so that the rope cannot wedge between the drum and the hoist frame.

.7 A paddle or weight-operated type upper final limit switch shall be provided to protect against hoisting beyond safe limits of travel. This switch shall be connected to open a main line contactor. The switch system must be designed in such a manner that the switch operator mechanism cannot be over travelled and allow the switch to become inoperative.

.8 A loading limit control device shall be provided to prevent over stressing the system. This device shall de-energize the hoist motor and immobilize the up circuit when an over capacity lift is attempted. This switch must be set to overcome dynamic loading conditions but not exceed 125% rated capacity.

.9 Geared upper and lower limit switches shall be furnished to restrict motion beyond the normal operating travel. These switch contacts shall be connected in the respective motor control circuits.

.10 The hoisting rope shall be improved plow steel, of suitable diameter, with a factor of safety of at least five (5). Connection to the drum shall be made adequately and shall be easily detachable for replacement.

.11 Lift:

.1 UV area hoists: 5.0 m (16.4 ft).

.12 Acceptable Product: CM, or approved equivalent.

2.3 Motors

.1 All motors shall be totally enclosed fan cooled (TEFC) type. They shall be 575 V, 3 phases, and rated for ten (10) minutes continuous operation under full load with a temperature rise not to exceed 20°C above an ambient temperature of 30°C.

2.4 Control Station

.1 A pendant type push-button station shall be provided to control the motions of trolley, and hoist for hoist system over the UV area. This station shall consist of buttons having the capability to control motion and speed in vertical and horizontal directions.

2.5 Hoist Control

.1 Speed control shall be provided for all travel and hoisting motions as outlined in Paragraph 2.4 of these Specifications.

.2 All single motions shall be controlled by VFD, reversing type motor starters provides variable speed for the hoists and trolleys.

.3 Fuse or circuit breaker protection shall be furnished for each individual motor.

.4 Forward and reverse motor contactors must be interlocked mechanically and electrically to prevent motor damage if the operator pushes the direction buttons simultaneously.

2.6 Electrical Wiring

.1 The complete electrical installation shall be made in accordance with the National Electric Code requirements and the conditions outlined in this specification.

.2 All electrical equipment shall be mounted in NEMA 4x enclosures.

.3 A grounding system shall be furnished to effectively maintain the enclosures of all electrical equipment such as motors, brakes, starters, push button stations, boxes, etc., at zero potential. Rigid conduit will provide adequate grounding continuity between enclosures when installed as noted above.

2.7 Fall Arrest Trolleys

.1 Three (3) required.

.2 190 kg capacity.

.3 Stainless Steel.

.4 Adjustable I-Beam.

.5 Acceptable Manufacturer:

.1 DBI-SALA.

.2 Or approved equivalent.

2.8 Self-Retracting Lanyards

.1 Three (3) required.

.2 Class A self-retracting lanyard.

.3 Stainless steel cable.

.4 3 m.

.5 Acceptable Manufacturer:

.1 DBI-SALA.

.2 Or approved equivalent.

2.9 Runway and Structure

.1 The runways shall consist of standard structural steel shapes. Refer to Section 05 12 23.

2.10 Painting

.1 All surfaces of the structural parts shall be cleaned, primed and painted.

.2 Clean metal surfaces shall be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes.

.3 Epoxy paint on all monorail/girder beam surfaces.

.4 Finish color shall be safety yellow.

.5 Apply rust preventing compound on machined surfaces.

.6 After completion of installation, thoroughly clean and touch-up the paint work as required.

2.11 Labelling

.1 Provide crane/hoist systems with permanent capacity labels as follows:

.1 Rated capacity in kilograms.

.2 Marked on each side of the monorail/runner beam.

.2 Hook block permanently marked with system capacity.

.3 Place the rated capacity labels on crane, hoist and load blocks at height and location easily read from floor level and loading position.

.4 A corrosion-resistant nameplate shall be fixed to the monorail, and trolley/hoist assembly with the following information.

.1 Name of manufacturer.

.2 Manufacture's model number and serial number.

.3 Capacity in Kilograms.

.4 Date of manufacture (month and year).

3. EXECUTION

3.1 Installation

.1 Install crane and hoist systems in accordance with Drawings and Specifications meeting the requirements of all applicable codes, standards, specifications and regulations.

.2 Do not modify crane or hoist components in any manner without advance, written approval by manufacturer.

.3 Provide all necessary material, labour, tools and equipment for the installation.

.4 Ensure that installation is carried out within the tolerances specified in this Section, and applicable codes and standards.

.5 Complete all necessary electrical connections to building connection point.

.6 Supply and install supports, hangers, etc. required to support electrical services from building connection point to crane/hoist system.

.7 Upon completion of installation, touch up and restore to new condition, damaged or defaced factory finished surfaces.

.8 Remove protective coverings and clean exposed surfaces after completion.

.9 Install the main disconnect and control panel for the crane/hoist at an accessible location.

.10 All hoist equipment shall be installed in accordance with manufacturer's instructions and recommendations.

.11 Bolted connections shall be in accordance with torque tightening procedures specified in.

.12 AISC Manual, Part 5.

3.2 Testing, Commissioning, Certification and Training

.1 All crane and hoisting equipment shall be operated through a complete lift and lowering cycle and through a complete travel of the bridge and trolley to determine the following:

.1 The equipment shall operate smoothly and safely.

.2 All tests shall be carried out with the crane and hoist systems loaded at 125% of capacity.

.3 Provide all necessary material, labour, tools and equipment required for all testing and commissioning.

.4 Supplier shall provide the test weight loads.

.1 Test weights shall be of minimal size and clearly labelled.

.5 Any defects shall be corrected by the Supplier without any expense to the City.

.6 Hook Block Tests:

.1 Establish a permanent throat base reference dimension before proof load testing, by making two trammel point marks on opposite sides of the hook throat.

.7 Crane and Hoist Tests:

.1 Test the cranes and hoists in accordance with applicable standards.

.8 Hook Tests:

.1 Inspect all hooks for throat spread after completion of the crane load tests. Re-measure the distance between trammel points.

.2 An increase of 1% or more of the throat dimension based on the hook throat opening will constitute failure of this inspection. Replace hooks failing to pass the inspection and retest at Contractor’s expense.

3.3 Training and Demonstration

.1 Upon successful completion of testing and commissioning of crane/hoist system, after the delivery of all documentation (manuals, drawings, certificates, etc.) and prior to issuance of Certificate of Completion, carry out equipment and system demonstration and training.

.2 Demonstrate operations and maintenance of equipment and systems and provide training to City’s operations and maintenance personnel.

.3 Provide certified personnel to demonstrate operation of crane/hoist system.

.4 Provide Contract Administrator a minimum of seven (7) days advance notice in writing of demonstration.

.5 Prior to demonstration, submit project record documents and operating and maintenance manuals to the Contract Administrator.

.6 Instruct maintenance personnel (one (1) hour minimum allowance) in basic maintenance and use of the crane/hoist system.

3.4 Warranty

.1 Vendor shall guarantee materials and workmanship of equipment installed under these specifications for a period of two (2) years after installation.

END OF SECTION

GENERAL PROCESS PROVISIONS

1. GENERAL

1.1 Requirements

.1 Provide complete, fully tested and operational process systems to meet requirements described herein and in complete accord with applicable codes and ordinances.

.2 This Section is to be read in conjunction with the provided process and instrumentation drawings and general arrangement drawings.

.3 Construction Contract Documents and Drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.

.4 Follow Manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Bid Documents.

.5 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to satisfaction of the Contract Administrator at no extra cost.

.6 Install equipment to provide access and ease of maintenance.

.7 The Contractor must supply and install the required identification, labeling or signage for each pipe, valve and piece of equipment, in accordance with the Best Practice Guideline for Occupational Safety and Health (OSHA) Pipes and Signage. In addition, the Contractor must be familiar with and follow the AECL Procedure WL-510445-PRO-667 for OSH Safety Signage Procedures.

.8 Contractor to coordinate for all process mechanical equipment power requirements and revisions to electrical distribution system. Acceptable voltages for equipment are 600V / 208V / 120V and 24V. If any actuator requires more than a 15 Amp breaker, then it shall be provided at the next highest voltage, up to a maximum of 600 V.

1.2 Discrepancies and Omissions

.1 These Specifications shall be considered as an integral part of the Drawings, which accompany them, and neither the Drawings nor Specifications shall be used alone. Any items or subject omitted from one but which is mentioned and/or indicated in the other shall be considered as properly and sufficiently specified and shall therefore be provided.

1.3 Transportation and Hoisting

.1 Assume responsibility for transportation, hoisting, warehousing, and demurrage for all equipment and materials to be furnished and installed under this Tender.

1.4 Definitions and Interpretations

.1 Where the term "Provide" is used herein, it shall be understood to include labour, materials, and services necessary to supply, install and make functional the items or Work referenced.

.2 Where the term "Instructions" or "As Instructed" or "Where Instructed", etc. is used herein, it shall be understood to mean as instructed in writing by the Contract Administrator.

.3 Where the term "Listed" is used herein, it shall be understood to mean that the materials or equipment have been tested in accordance with applicable standards and methods, have been approved and listed for the intended use by a testing authority which itself has been approved by the Authorities Having Jurisdiction.

.4 Where the term "Approved", "Approval", etc. is used herein, it shall be understood to mean approved by Authorities Having Jurisdiction as conforming to Codes, Standards, By-Laws, etc.

.5 Where the term "Acceptable" or "Acceptance", etc. is used herein, it shall be understood to mean acceptable to the Contract Administrator as conforming to the requirements of the Construction Contract Documents.

.6 Where the term "Submit for Review" is used herein, it shall be understood to mean submit in writing to the Contract Administrator.

.7 Where the term "Subject to Review" etc. is used herein, it shall be understood to mean Work shall be laid out for review by the Contract Administrator. No Work shall proceed until written instructions have been obtained from the Contract Administrator. Submit further information, Shop Drawings, samples, etc. as specified and/or as may be reasonably requested by the Contract Administrator.

.8 Where the term "Accessible" is used herein, it shall be understood to mean readily approachable by person or tools as required and where obstacles may be removed and replaced without cutting or breaking out materials.

.9 Where working pressure or pressure ratings are specified or shown on the Drawings for valves, piping, fittings, equipment, etc., these items shall be suitable for operating at specified pressures and corresponding temperature unless noted otherwise.

.10 I/Os from stand-alone control panels shall be interfaced with main Process Control System (PCS) via hardwired as shown on P&IDs, unless indicated otherwise. In addition to hardwired I/Os, provide Modbus TCP/IP link for additional monitoring status to main PCS. If this is not available, notify the Contract Administrator immediately and revise I/Os to hardwired interface to main PCS.

1.5 Shop Drawings

.1 Refer to Section 01 33 00 for the general requirements for Shop Drawings.

.2 For specific requirements for Shop Drawings for various pieces of equipment, refer to the relevant specific Sections describing the equipment.

1.6 Coordination

.1 Coordinate with other Divisions the location of openings, housekeeping pads and anchor bolts.

.2 Coordinate the connection of the services of other Divisions to the equipment and material supplied under this Division.

1.7 Minor Changes

.1 Equipment and materials shall be located and arranged generally as shown on the Drawings. However, minor changes may be required to suit the precise requirements of the actual equipment or materials supplied, or to avoid conflict between services.

.2 Prior to the installation of the relevant equipment or materials, the Contractor shall advise the Contract Administrator of the requirement for any minor changes (including box-outs and coring) and shall undertake such minor changes as instructed by the Contract Administrator. Such changes shall be undertaken at no extra cost except where the connection or arrangement is modified in length, or alignment, or position, by more than 1 m; or if the change involves the addition of more than two (2) fittings greater than 150 mm in diameter.

.3 The building envelope layout and structural components cannot be modified.

1.8 Cutting and Patching

.1 Provide holes and sleeves, cutting and fitting required for mechanical Work. Relocate improperly located holes and sleeves.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from the Contract Administrator before cutting or burning structural members.

.4 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective Section.

1.9 Substantial Performance and Construction Completion

.1 Prior to Substantial Performance, provide a complete list of items which are deficient at the time of the Substantial Performance inspection.

.2 Perform the following items prior to Substantial Performance inspection:

.1 Make systems capable of operation with alarm controls functional and automatic controls in operation generally, but not necessarily finally calibrated.

.2 Make necessary tests on equipment including those required by authorities. Obtain certificates of approval.

.3 Complete valve tagging and identify equipment. Paint equipment, piping and install escutcheon.

.4 Lubricate equipment in accordance with the Manufacturer's data.

.5 Mail warranty forms to Manufacturer. Provide copy of original warranty for equipment which has Maintenance Period longer than one (1) year.

.6 Submit Operation and Maintenance Manuals in accordance with Section 01 33 00 and Section 01 78 23.

.3 Prior to Construction Completion Inspection, provide declaration in writing that deficiencies noted at time of Substantial Performance Inspection have been corrected and the following items completed prior to the Construction Completion Inspection:

.1 Complete final calibration of controls.

.4 The Contractor shall provide qualified personnel in appropriate numbers to maintain the facility until Substantial Performance is declared. Operation of equipment will be by City upon successful completion of Running Test for each UV channel.

1.10 Equipment Protection and Clean-Up

.1 Protect equipment and materials in storage on Site during 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 Thoroughly clean both existing and new piping, ducts and equipment of dirt, cuttings and other foreign substances.

.4 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.11 Temporary Usage

.1 Usage by the City of any process device, apparatus, machinery or equipment prior to Construction Completion being issued is not to be construed as acceptance.

1.12 Acceptable Products and Manufacturers

.1 Wherever possible, all equipment and related coatings, lubricants, etc. shall be NSF/ANSI Standard 61 approved.

1.13 Spare Parts and Special Tools

.1 If spare parts or special tools are to be provided with any equipment specified, the specific parts or tools will be listed in the relevant Specification Section and are to be supplied with the equipment.

.2 Where the operation of the equipment for two (2) years would require that some specific spare parts be provided, but are not listed in the Specification, the Contractor shall so inform the Contract Administrator. Costs, delivery periods, and any other information relevant to the procurement of the identified spare parts shall be identified.

.3 Where some specific special tools are required for the maintenance and/or operation of a specific item of equipment, but are not listed, the Contractor shall inform the Contract Administrator. Costs, delivery periods, and any other information relevant to the procurement of the identified special tools shall be provided.

.4 This clause does not relieve the Contractor of the responsibility to provide, at no cost, any spare parts required during the maintenance period to repair malfunctioning or failed

equipment. At the end of the maintenance period, the spare parts inventory shall be replenished.

1.14 Abbreviations

.1 ABMA - American Bearing Manufacturers Association.

.2 AISI - American Iron and Steel Institute.

.3 ANSI - American National Standards Institute.

.4 API - American Petroleum Institute.

.5 ASME - American Society of Mechanical Consultants.

.6 ASTM - ASTM International (formerly American Society for Testing and Materials).

.7 AWS - American Welding Society.

.8 AWWA - American Water Works Association.

.9 CGA - Canadian Gas Association.

.10 CGSB - Canadian General Standards Board.

.11 CISPI - Cast Iron Soil Pipe Institute.

.12 CPC - Canadian Plumbing Code.

.13 CSA - Canadian Standards Association.

.14 EJMA - Expansion Joint Manufacturer's Association.

.15 MIL - Military Standard.

.16 MSS - Manufacturers Standardization Society of the Valve and Fittings Industry.

.17 NACE - NACE International (formerly National Association of Corrosion Consultants).

.18 NSF - NSF International (formerly National Sanitation Foundation).

.19 SSPC - Society for Protective Coatings.

2. PRODUCTS

2.1 Spare Parts

.1 Spare parts are to be supplied by the Contractor as required in the various Specification Sections. The lists in these Sections are intended to include all parts which normally would be required within a single year for normal preventative maintenance and where fabrication requirements for special parts would delay delivery and could keep an item of equipment out of service for an extended period.

.2 Any special spare parts not listed shall be identified by the Contractor, with a price list.

.3 In addition, the Contractor shall provide a list of all spare parts, not including lubricants, which normally would be required through the first five (5) years of operation. Provide prices for each part, guaranteed for six (6) months.

.4 The Contractor shall be responsible to replenish the spare parts used in the initial year of operation at the end of the maintenance period for the related item(s) of equipment.

3. EXECUTION

3.1 Training

.1 Scheduling of training is to be arranged with the Contract Administrator.

.2 The training will be by the Manufacturer's Representative and/or the Installer Trades and will include maintenance procedures, troubleshooting, and repair procedures for all electrical and mechanical components. Contractor to assist and coordinate operator training.

END OF SECTION