

**Part 1            General**

**1.1                MINIMUM STANDARDS**

- .1    Execute Work to meet or exceed the latest edition of:
  - .1    Manitoba Building Code, including all amendments up to project date.
  - .2    Rules and regulations of authorities having jurisdiction.
  - .3    Occupational Health and Safety Act,
  - .4    Canadian Construction Safety Code,
  - .5    Contract documents.
  - .6    Workplace Safety and Health;
  - .7    Canadian Electrical Code;

**1.2                STORAGE OF EQUIPMENT AND MATERIALS**

- .1    Contractor to co-ordinate with the Contract Administrator.

**1.3                FEES, PERMITS AND CERTIFICATES**

- .1    Provide authorities having jurisdiction with information requested.
- .2    Pay fees and obtain certificates and permits required.
- .3    Furnish certificates and permits when requested.

**1.4                DOCUMENTS**

- .1    Keep on copy of contract documents and shop drawings on the site.

**1.5                AS-BUILT RECORD DRAWINGS**

- .1    As Work progresses and as required, record significant deviations from the Contract drawings. Prior to Preliminary Acceptance, submit one copy of As-Constructed drawings to Contract Administrator. Refer to sections 01 33 00 – Submittal Procedures and 01 78 00 – Closeout Submittals.

**1.6                MATERIAL AND EQUIPMENT**

- .1    Use new products unless otherwise specified.
- .2    Deliver and store material and equipment to manufacturer's instructions with manufacturer's labels and seals intact.

**1.7                CUTTING AND REMEDIAL WORK**

- .1    Coordinate Work to keep cutting and remedial Work to a minimum.

**1.8                FASTENINGS**

- .1    Provide fastenings of type, size and spacing required to assure secure anchorage.
  - .2    Obtain Contract Administrator's approval before using explosive actuated fasteners.
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## **1.9 CONSTRUCTION TIME AND SCHEDULING**

- .1 In conjunction with and in form acceptable to Contract Administrator provide within 10 working days after contract award, schedule showing dates for:
- Submission of shop drawings, material tests and samples.
  - Delivery of equipment and materials.
  - Commencement and completion of Work of each major component of the Work.
  - Final completion date within time period required by contract documents.

## **1.10 SUPERVISION**

- .1 Provide the necessary supervision and qualified tradesmen to ensure that flow of materials and on-site installation compatible with the overall project schedule and progress.

## **1.11 CONTRACTOR'S USE OF PREMISES**

- .1 The Contract Administrator will define the Contractor's use of the premises.  
.2 Make arrangements with the Contract Administrator if additional areas are required. Obtain written agreements and submit copies to Contract Administrator.  
.3 Confine operations within easements for construction, storage and access as shown on Contract Drawings.  
.4 Service shutdowns that impact the normal operation of the facility shall be limited to after hour shifts not exceeding 8 hours. All services shall be restored prior to opening of the facility next day. The dates of shutdowns shall be co-ordinated with the Contract Administrator.  
.5 Protect landscaping from damage due to construction activities. Restore any damages caused by construction activities to original condition.

## **1.12 QUALITY CONTROL**

- .1 Adhere to manufacturer's recommendations with respect to handling, preparation, installation, testing, operation or protection of any product or material to be incorporated in Work.  
.2 Ensure that all materials supplied are compatible with each other unless specific adjacent materials have been specified. Correct any defective Work caused by non-compatibility of materials.  
.3 Where practical or desirable, tests will be conducted by Contract Administrator on materials and equipment to be incorporated into permanent Works before delivery to site.  
.4 Submit to Contract Administrator full information on materials, equipment and related arrangements to be furnished.  
.5 Submit information in a form approved by Contract Administrator  
.6 Submit sufficient information to enable Contract Administrator to determine whether proposed materials, equipment, and arrangements meet contract requirements.

## **1.13 PROJECT MEETINGS**

1. Project meeting will be held at times and locations approved by the Contract Administrator.

## **1.14 DEMONSTRATION AND TRAINING**

- .1 Provide training as per Section 01 79 00 – Demonstration and Training.
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**Part 2            Products**

**2.1                NOT USED**

.1                Not Used.

**Part 3            Execution**

**3.1                NOT USED**

.1                Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                ADMINISTRATIVE**

- .1        Submit to Contract Administrator submittals listed for review. Submit promptly and in 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        Do not proceed with Work affected by submittal until review is complete.
- .3        Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4        Where items or information is not produced in SI Metric units converted values are acceptable. 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. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .5        Notify Contract Administrator, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .6        Verify field measurements and affected adjacent Work are co-ordinated.
- .7        Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
- .8        Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator review.
- .9        Keep one reviewed copy of each submission on site.

**1.2                SHOP DRAWINGS AND PRODUCT DATA**

- .1        The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
  - .2        Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
  - .3        Allow 14 days for Contract Administrator's review of each submission.
  - .4        Adjustments made on shop drawings by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.
  - .5        Make changes in shop drawings as Contract Administrator may require, consistent with Contract Documents. When resubmitting, notify Contract Administrator in writing of revisions other than those requested.
  - .6        Accompany submissions with transmittal letter, containing:
    - .1        Date.
    - .2        Project title and number.
    - .3        Contractor's name and address.
    - .4        Identification and quantity of each shop drawing, product data and sample.
    - .5        Other pertinent data.
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- .7 Submissions include:
    - .1 Date and revision dates.
    - .2 Project title and number.
    - .3 Name and address of:
      - Subcontractor.
      - Supplier.
      - Manufacturer.
    - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
    - .5 Details of appropriate portions of Work as applicable:
      - Fabrication.
      - Layout, showing dimensions, including identified field dimensions, and clearances.
      - Setting or erection details.
      - Capacities.
      - Performance characteristics.
      - Standards.
      - Operating weight.
      - Wiring diagrams.
      - Single line and schematic diagrams.
      - Relationship to adjacent Work.
  - .8 After Contract Administrator's review, distribute copies.
  - .9 Submit electronic (PDF format) copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Contract Administrator where shop drawings will not be prepared due to standardized manufacture of product.
  - .10 Submit electronic (PDF format) copies of test reports for requirements requested in specification Sections and as requested by Contract Administrator.
    - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
  - .11 Submit electronic (PDF format) copies of certificates for requirements requested in specification Sections and as requested by Contract Administrator.
    - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
    - .2 Certificates must be dated after award of project contract complete with project name.
  - .12 Submit one electronic PDF copy and 3 hard copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Contract Administrator.
  - .13 Delete information not applicable to project.
  - .14 Supplement standard information to provide details applicable to project.
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- .15 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

**1.3 PHOTOGRAPHIC DOCUMENTATION**

- .1 Submit electronic copy of colour digital photography in jpg format, standard resolution monthly with progress statement and as directed by Contract Administrator.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Frequency of photographic documentation: weekly.
- .1 Upon completion of: excavation, foundation, framing and services before concealment, and as directed by Contract Administrator.

**Part 2 Products**

**2.1 NOT USED**

**Part 3 Execution**

**3.1 NOT USED**

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Province of Manitoba
  - .1 The Workers Compensation Act RSM 1987 - Updated 2006.

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
  - .1 Results of site-specific safety hazard assessment.
  - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in Work plan.
- .3 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .4 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

**1.3                SAFETY ASSESSMENT**

- .1 Perform site specific safety hazard assessment related to project.

**1.4                GENERAL REQUIREMENTS**

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

**1.5                RESPONSIBILITY**

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

**1.6                COMPLIANCE REQUIREMENTS**

- .1 Comply with The Workers Compensation Act, Workplace Safety Regulation.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

**1.7                UNFORESEEN HAZARDS**

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Contract Administrator verbally and in writing.

**1.8 HEALTH AND SAFETY CO-ORDINATOR**

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
  - .1 Have working knowledge of occupational safety and health regulations.
  - .2 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
  - .3 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

**1.9 POSTING OF DOCUMENTS**

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction.

**1.10 CORRECTION OF NON-COMPLIANCE**

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction.

**1.11 WORK STOPPAGE**

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not used.

**END OF SECTION**

**Part 1            General**

**1.1                INSPECTION**

- .1 Allow Contract Administrator access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Contract Administrator instructions, or law of Place of Work.
- .3 If 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.
- .4 Contract Administrator will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such Work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Contract Administrator shall pay cost of examination and replacement.

**1.2                INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies will be engaged by Contract Administrator for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Contract Administrator.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Contract Administrator at no cost to Contract Administrator. Pay costs for retesting and re-inspection.

**1.3                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.

**1.4                PROCEDURES**

- .1 Notify appropriate agency and 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 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.

**1.5                REJECTED WORK**

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by

Contract Administrator as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

- .2 Make good other Contractor's Work damaged by such removals or replacements promptly.
- .3 If in opinion of Contract Administrator, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Contract Administrator will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents.

## **1.6 REPORTS**

- .1 Submit electronic copy of inspection and test reports to Contract Administrator.
- .2 Provide copies to Subcontractor of Work being inspected or tested, manufacturer or fabricator of material being inspected or tested.

## **1.7 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 Contract Documents or beyond those required by law of Place of Work will be appraised by Contract Administrator and may be authorized as recoverable.

## **1.8 MOCK-UPS**

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to Contract Administrator.
- .3 Prepare mock-ups for Contract Administrator review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups 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.
- .5 If requested, Contract Administrator will assist in preparing schedule fixing dates for preparation.
- .6 Remove mock-up when acceptable to Contract Administrator.
- .7 Mock-ups may remain as part of Work when acceptable to Contract Administrator.
- .8 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

## **1.9 MILL TESTS**

- .1 Submit mill test certificates as required of specification Sections or requested by Contract Administrator.

## **1.10 EQUIPMENT AND SYSTEMS**

- .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.
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**Part 2            Products**

**2.1                NOT USED**

.1                Not Used.

**Part 3            Execution**

**3.1                NOT USED**

.1                Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1        U.S. Environmental Protection Agency (EPA) / Office of Water
  - .1        EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

**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.

**1.3                TEMPORARY HEATING AND VENTILATION**

- .1        Provide temporary heating and ventilation as required during construction period, including attendance, maintenance and fuel.

**1.4                TEMPORARY POWER AND LIGHT**

- .1        Contractor is responsible for all power and lighting required during construction.
- .2        Provide and maintain temporary lighting throughout project.

**1.5                TEMPORARY COMMUNICATION FACILITIES**

- .1        Provide and pay for temporary telephone, fax, data hook up, necessary for own use.

**1.6                FIRE PROTECTION**

- .1        Provide and maintain temporary fire protection equipment during performance of Work required by governing codes and regulations.
- .2        Burning rubbish and construction waste materials is not permitted on site.

**Part 2            Products**

**2.1                NOT USED**

- .1        Not Used.

**Part 3            Execution**

**3.1                NOT USED**

**END OF SECTION**

**Part 1            General**

**1.1                SCOPE OF WORK**

- .1            Provide construction facilities as detained herein.

**1.2                REFERENCE STANDARDS**

- .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.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4                INSTALLATION AND REMOVAL**

- .1            Prepare site plan indicating proposed location and dimensions of area to be fenced and used by 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.

**1.5                SCAFFOLDING**

- .1            Scaffolding in accordance with CAN/CSA-S269.2.
- .2            Provide and maintain scaffolding, ramps, platforms, ladders, and temporary stairs.

**1.6                HOISTING**

- .1            Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2            Hoists to be operated by qualified operator.

**1.7                SITE STORAGE/LOADING**

- .1            Confine Work and operations of employees by 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 Work.
- .3 New equipment and materials shall not be stored outside exposed to weather conditions.

#### **1.8 CONSTRUCTION PARKING**

- .1 Parking will be permitted on site provided it does not disrupt performance of the City's normal operations. Refer to Appendix G for parking area designated for this project. Additional parking above and beyond amount available in the designated area is the responsibility of the Contractor.
- .2 Provide and maintain adequate access to project site.

#### **1.9 SECURITY**

- .1 Construction site security, including laydown areas, is the responsibility of the contractor.
- .2 The Contractor must receive approval from the City prior to hiring 24-hour security staff for their laydown area.

#### **1.10 OFFICES**

- .1 Contractor may provide an office trailer within the designated laydown area at their discretion.
- .2 Provide marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

#### **1.11 EQUIPMENT, TOOL AND MATERIALS STORAGE**

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with Work activities.

#### **1.12 SANITARY FACILITIES**

- .1 Provide sanitary facilities for workforce in accordance with governing regulations and ordinances. Locate in area(s) designated by Contract Administrator.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.
- .3 Contractor shall **not** use any the exiting sanitary facilities within the buildings of NEWPCC Site.

#### **1.13 CONSTRUCTION SIGNAGE**

- .1 No other signs or advertisements, other than warning signs, are permitted on site.
- .2 Graphic symbols 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 Contract Administrator.

#### **1.14 PROTECTION AND MAINTENANCE OF TRAFFIC**

- .1 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
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- .2 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .3 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.

**1.15 CLEAN-UP**

- .1 Work areas shall be cleaned **daily**. Incorporate effective dust control measures to keep the piping and pipe wrap in clean condition.
- .2 Remove construction debris, waste materials, packaging material from worksite **daily**.
- .3 Clean dirt or mud tracked into facility immediately.
- .4 Store materials resulting from demolition activities that are salvageable in designated areas.
- .5 Stack stored new or salvaged material not in construction facilities.
- .6 Snow clearing of the construction site and site access as and when required is the responsibility of the contractor.

**1.16 SITE LAYDOWN AREA**

- .1 See Appendix A for details of the Contractor laydown area.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                PROJECT CLEANLINESS**

- .1      Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2      Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Contract Administrator. Do not burn waste materials on site.
- .3      Clear snow and ice from access to building, bank/pile snow in designated areas only.
- .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.
- .7      Dispose of waste materials and debris 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 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 products and debris.
  - .5      Remove waste materials from site at regularly scheduled times or dispose of as directed by Contract Administrator. Do not burn waste materials on site.
  - .6      Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
  - .7      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.
  - .8      Remove stains, spots, marks and dirt from decorative Work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
  - .9      Clean lighting reflectors, lenses, and other lighting surfaces.
  - .10     Vacuum clean and dust building interiors, behind grilles, louvres and screens.
  - .11     Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
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- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roofs, downspouts, and drainage systems.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .20 Remove snow and ice from access to building.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

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**Part 1 GENERAL**

**1.01 SECTION INCLUDES**

- .1 Text, schedules and procedures for systematic Waste Management Program for construction, deconstruction, demolition, and renovation projects.

**1.02 INTENT**

- .1 Minimize the amount of non-hazardous solid waste generated and maximize the reduction, reuse, and recycling of solid waste produced by this Work.
- .2 Furnish all labour and equipment to collect, remove and dispose of all waste materials found on site prior to commencing Work and/or generated as a result of operations during any phase of construction.
- .3 Respect environmental regulations and prevent environmental pollution damage.

**1.03 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures

**1.04 DEFINITIONS**

- .1 **Recyclable:** Ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse by others.
- .2 **Recycle:** Process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .3 **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.
- .4 **Reuse:** Repeated use of product in same form but not necessarily for same purpose. Reuse includes:
- .5 **Salvaging:** reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
- .6 **Returning:** reusable items including pallets or unused products to vendors.
- .7 **Salvage:** Removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .8 **Source Separation:** Acts of keeping different types of waste materials separate beginning from first time they became waste.

**1.05 STORAGE, HANDLING AND PROTECTION**

- .1 Provide on-site facilities and containers for collection and storage of reusable and recyclable materials.
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- .2 Store, materials to be reused, recycled and salvaged in locations as directed by Waste Management Coordinator.
- .3 Unless specified otherwise, materials for removal become Contractor's property.
- .4 Protect, stockpile, store and catalogue salvaged items.
- .5 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .6 Protect surface drainage, mechanical and electrical from damage and blockage.
- .7 Separate and store materials produced during dismantling of structures in designated areas.
- .8 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
- .9 Separate and store materials produced during project in designated areas.
- .10 Remove co-mingled materials to off-site processing facility for separation.
- .11 Provide waybills for separated materials removed from site.
- .12 Materials reused on-site are considered to be diverted from landfill and as such are to be included in all reporting.

#### **1.06 WASTE DISPOSAL**

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of liquid waste into waterways, storm, or sanitary sewers.
- .3 Keep records of construction waste including:
  - .1 Number and size of bins.
  - .2 Waste type of each bin.
  - .3 Total tonnage generated.
  - .4 Tonnage reused or recycled.
  - .5 Reused or recycled waste destination.
  - .6 Weigh bills from all waste and recycling destinations
- .4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.
- .6 Consult with and obtain approval of Contract Administrator before removing waste materials.
- .7 Dispose of materials unsuitable for reuse at option of Contractor, by means and at locations of choice. Upon approval of Contract Administrator, disposal areas may be located near building site.
- .8 Trim stockpiles and waste to neat and presentable appearance.

- .6 Take every precaution not to damage adjacent building finishes, or overhead or underground utilities. Retain liability for repair of damages occurring in performance of Work.

#### **1.07 USE OF SITE AND FACILITIES**

- .1 Execute Work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by existing facility.

#### **1.08 SCHEDULING**

- .1 Coordinate Work with other activities at site to ensure timely and orderly progress of Work.

#### **1.09 ENVIRONMENTAL REQUIREMENTS**

- .1 Where Work includes handling, hauling and disposing of environmentally sensitive (containment/pollutant), or hazardous materials, so such Work and locate waste or disposal areas to requirements, standards and approval of Manitoba Environment and Workplace Safety and Health, and all applicable regulations.

### **2 PRODUCTS**

#### **2.01 NOT USED**

Not Used.

### **3 EXECUTION**

#### **3.01 APPLICATION**

- .1 Handle waste materials not reused, salvaged, or recycled, in accordance with all appropriate regulations and codes.

#### **3.02 CLEANING**

- .1 Clean the Place of Work regularly. Leave areas clean at the end of each day.
- .2 Perform final cleaning at project completion and remove surplus waste, materials, rubbish, tools, and equipment in accordance with Section 01 74 11 - Cleaning and as follows:
- .3 Remove recycling containers and bins from site and dispose of materials at appropriate facilities.
- .4 Separate materials to be reused/recycled into specific collection bins.

#### **3.03 DIVERSION OF MATERIALS**

- .1 From following list below, separate waste materials into separate piles or containers as coordinated by the Waste Management Coordinator, and in compliance with applicable fire regulations.
- .2 Clearly label containers or stockpiles for each type of material.

- .3 Provide instruction on disposal practices.
- .4 On-site sale of materials is not permitted unless approved by Contract Administrator.

**END OF SECTION**

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**Part 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 maintenance and operation of described products.
- .3        Copy will be returned with Contract Administrator's comments.
- .4        Revise content of documents as required prior to final submittal.
- .5        Two weeks prior to Substantial Performance of the Work, submit to the Contract Administrator, three final copies of operating and maintenance manuals in English.
- .6        Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .7        Furnish evidence, if requested, for type, source and quality of products provided.
- .8        Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .9        Pay costs of transportation.

**1.2                FORMAT**

- .1        Organize data as instructional manual.
- .2        Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3        When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4        Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project 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        Text: manufacturer's printed data, or typewritten data.
- .8        Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

**1.3                CONTENTS - EACH VOLUME**

- .1        Table of Contents: provide title of project; Date of submission; names.
  - .1        Addresses, and telephone numbers of Contract Administrator and Contractor with name of responsible parties.
  - .2        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.
- .5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure.
- .6 Training: refer to Section 01 79 00 - Demonstration and Training.

#### **1.4 AS-BUILTS AND SAMPLES**

- .1 Maintain, in addition to requirements in General Conditions, at site for Contract Administrator one record copy of:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Change Orders and other modifications to Contract.
  - .5 Reviewed shop drawings, product data, and samples. Field test records.
  - .6 Inspection certificates.
  - .7 Manufacturer's certificates.
- .2 Store record documents and samples in 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 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 Contract Administrator.

#### **1.5 RECORDING ACTUAL SITE CONDITIONS**

- .1 Record information on set of black line opaque drawings provided by Contract Administrator.
- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 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 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, field test records, required by individual specifications sections.

## **1.6 EQUIPMENT AND SYSTEMS**

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 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.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Additional requirements: as specified in individual specification sections.

## **1.7 MATERIALS AND FINISHES**

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-Protection and Weather-Exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: as specified in individual specifications sections.

## **1.8 SPARE PARTS**

- .1 Provide spare parts, in quantities specified in individual specification sections.

- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to site; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Contract Administrator. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

**1.9 MAINTENANCE MATERIALS**

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to site; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Contract Administrator. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

**1.10 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. Receive and catalogue items. Submit inventory listing to Contract Administrator. Include approved listings in Maintenance Manual.

**1.11 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.

**1.12 WARRANTIES AND BONDS**

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Contract Administrator approval.
- .3 Warranty management plan to include required actions and documents to assure that Contract Administrator receives warranties to which it is entitled.
- .4 Provide 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 construction phase, to Contract Administrator for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder and submit upon acceptance of Work. Organize binder as follows:
  - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

- .2 List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Obtain warranties and bonds, executed in duplicate by Subcontractors, suppliers, and manufacturers, within ten days after completion of 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 Except for items put into use with Contract Administrator's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, Subcontractors, manufacturers or suppliers involved.
  - .2 Provide 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-year overall warranty of construction. 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 warranty period.
    - .9 Summary of maintenance procedures required to continue warranty in force.
    - .10 Cross-Reference to specific pertinent Operation and Maintenance 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 of 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 in a timely manner 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 Contract Administrator to proceed with action against Contractor.

**1.13 WARRANTY TAGS**

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Contract Administrator.
  - .2 Attach tags with copper wire and spray with waterproof silicone coating.
  - .3 Leave date of acceptance until project is accepted for occupancy.
-

- .4 Indicate following information on tag:
  - .1 Type of product/material.
  - .2 Model number.
  - .3 Serial number.
  - .4 Contract number.
  - .5 Warranty period.
  - .6 Inspector's signature.
  - .7 Construction Contractor.
  - .8 Installation Date:

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

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**Part 1            General**

**1.1            DESCRIPTION**

- .1    Demonstrate scheduled operation and maintenance of equipment and systems to Contract Administrator's personnel two weeks prior to date of final inspection.
- .2    Contractor shall submit the course contents to Contract Administrator's review minimum of 2 weeks prior to the training session. The Contractor shall incorporate all comments from the Contract Administrator and submit the finalized course content at least two weeks prior to first training session.
- .3    Contract Administrator will provide list of personnel to receive instructions, and will co-ordinate their attendance at agreed-upon times.

**1.2            QUALITY CONTROL**

- .1    When specified in individual Sections require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Contract Administrator's personnel, and provide written report that demonstration and instructions have been completed.

**1.3            SUBMITTALS**

- .1    Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Contract Administrator's approval. Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3    Give time and date of each demonstration, with list of persons present.

**1.4            CONDITIONS FOR DEMONSTRATIONS**

- .1    Equipment has been inspected and put into operation.
- .2    Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

**1.5            PREPARATION**

- .1    Verify that conditions for demonstration and instructions comply with requirements.
- .2    Verify that designated personnel are present.

**1.6            DEMONSTRATION AND INSTRUCTIONS**

- .1    Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment location.
- .2    Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
- .3    Review contents of manual in detail to explain aspects of operation and maintenance.
- .4    Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.

**1.7            TIME ALLOCATED FOR INSTRUCTIONS**

- .1    For each training session, allow full 8 hour day for instruction and training.
-

- Part 2**            **Products**
- 2.1**                **NOT USED**
- .1        Not Used.

- Part 3**            **Execution**
- 3.1**                **NOT USED**
- .1        Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Acronyms:
  - .1 Cx - Commissioning.
  - .2 O&M - Operation and Maintenance.
  - .3 PI - Product Information.
  - .4 PV - Performance Verification.
  - .5 TAB - Testing, Adjusting and Balancing.

**1.2 COMMISSIONING PLAN**

- .1 Comprehensive commissioning plan shall be provided by Contractor for the review of Contract Administrator minimum of two weeks prior to commissioning. The commissioning plan shall detail list of actions to be carried out on each day of commissioning period. The commissioning plan shall include a schedule that would indicate the dates of commissioning. It shall also include commissioning forms to be filled out by the Contractor to record and document the results of commissioning procedures. (Commissioning forms are to be developed by Contractor with input from Contract Administrator.)

**1.3 GENERAL**

- .1 CX is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
  - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
  - .2 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
  - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
  - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

**1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS**

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Contract Administrator, to ensure effective performance.
- .2 Costs for corrective Work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

**1.5 PRE-CX REVIEW**

- .1 Before Construction:
  - .1 Review contract documents, confirm by writing to Contract Administrator.
    - .1 Adequacy of provisions for Cx.
    - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
  - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
  - .1 Have completed Cx Plan up-to-date.
  - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
  - .3 Fully understand Cx requirements and procedures.
  - .4 Have Cx documentation shelf-ready.
  - .5 Understand completely design criteria and intent and special features.
  - .6 Submit complete start-up documentation to Contract Administrator.
  - .7 Have Cx schedules up-to-date.
  - .8 Ensure systems have been cleaned thoroughly.
  - .9 Complete TAB procedures on systems, submit TAB reports to Contract Administrator for review and approval.
  - .10 Ensure "As-Built" system schematics are available.
- .4 Inform Contract Administrator in writing of discrepancies and deficiencies on finished Works.

**1.6 SUBMITTALS**

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

**1.7 COMMISSIONING DOCUMENTATION**

- .1 Contract Administrator to review and approve Cx documentation.
- .2 Provide completed and approved Cx documentation to Contract Administrator.

**1.8 STARTING AND TESTING**

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

**1.9 WITNESSING OF STARTING AND TESTING**

- .1 Provide 14 days' notice prior to commencement.
- .2 Contract Administrator representative to witness of start-up and testing.

**1.10 MANUFACTURER'S INVOLVEMENT**

- .1 Factory testing: manufacturer to:
  - .1 Coordinate time and location of testing.
  - .2 Provide testing documentation for approval by Contract Administrator.
  - .3 Obtain written approval of test results and documentation from Contract Administrator before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Contract Administrator.

- .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
- .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
  - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
  - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
  - .1 Experienced in design, installation and operation of equipment and systems.
  - .2 Ability to interpret test results accurately.
  - .3 To report results in clear, concise, logical manner.

### **1.11 PROCEDURES**

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
  - .1 Included in delivery and installation:
    - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
    - .2 Visual inspection of quality of installation.
  - .2 Start-up: follow accepted start-up procedures.
  - .3 Operational testing: document equipment performance.
  - .4 System PV: include repetition of tests after correcting deficiencies.
  - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Contract Administrator after distinct phases have been completed and before commencing next phase.
- .4 Document required tests on approved PV forms.

### **1.12 START-UP DOCUMENTATION**

- .1 Assemble start-up documentation and submit to Contract Administrator for approval before commencement of commissioning.
- .2 Start-up documentation to include:
  - .1 Factory and on-site test certificates for specified equipment.
  - .2 Pre-start-up inspection reports.
  - .3 Signed installation/start-up check lists.
  - .4 Start-up reports,
  - .5 Step-by-step description of complete start-up procedures, to permit Contract Administrator to repeat start-up at any time.

### **1.13 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS**

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
  - .2 With assistance of manufacturer develop written maintenance program and submit Contract Administrator for approval before implementation.
-

- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

**1.14 TEST RESULTS**

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

**1.15 START OF COMMISSIONING**

- .1 Start Cx after elements of the facility affecting start-up and performance verification of systems have been completed.

**1.16 INSTRUMENTS / EQUIPMENT**

- .1 Provide the following equipment as required:
  - .1 2-way radios.
  - .2 Ladders.
  - .3 Equipment as required to complete Work.

**1.17 COMMISSIONING PERFORMANCE VERIFICATION**

- .1 Carry out Cx:
  - .1 Under accepted simulated operating conditions, over entire operating range, in all modes.
  - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

**1.18 WITNESSING COMMISSIONING**

- .1 Contract Administrator representative to witness activities and verify results.

**1.19 AUTHORITIES HAVING JURISDICTION**

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Contract Administrator within 5 days of test and with Cx report.

**1.20 REPEAT VERIFICATIONS**

- .1 Assume costs incurred by Contract Administrator for third and subsequent verifications where:
  - .1 Verification of reported results fail to receive Contract Administrator's approval.
  - .2 Repetition of second verification again fails to receive approval.

- .3 Contract Administrator deems Contractor's request for second verification was premature.

**1.21 DEFICIENCIES, FAULTS, DEFECTS**

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Contract Administrator.
- .2 Report problems, faults or defects affecting Cx to Contract Administrator in writing. Stop Cx until problems are rectified. Proceed with written approval from Contract Administrator.

**1.22 COMPLETION OF COMMISSIONING**

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Contract Administrator.

**1.23 ACTIVITIES UPON COMPLETION OF COMMISSIONING**

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

**1.24 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS**

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

**1.25 OCCUPANCY**

- .1 Cooperate fully with Contract Administrator during stages of acceptance and occupancy of facility.

**1.26 INSTALLED INSTRUMENTATION**

- .1 Use instruments installed under Contract for TAB and PV if:
  - .1 Accuracy complies with these specifications.
  - .2 Calibration certificates have been deposited with Contract Administrator.

**1.27 PERFORMANCE VERIFICATION TOLERANCES**

- .1 Application tolerances:
  - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10 of specified values.
- .2 Instrument accuracy tolerances:
  - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
  - .1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

**1.28 PERFORMANCE TESTING**

- .1 Performance testing of equipment or system by Contract Administrator will not relieve Contractor from compliance with specified start-up and testing procedures.

- Part 2**            **Products**
- 2.1**            **NOT USED**
- .1        Not Used.

- Part 3**            **Execution**
- 3.1**            **NOT USED**
- .1        Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                SCOPE OF WORK**

- .1    Supply and installation of floor drains and associated drainage piping.
- .2    Provide floor penetrations and coring. Scan floors prior to coring. Do not core through concrete beams.
- .3    Obtain approval from the Contract Administrator for floor penetration locations prior to proceeding with the Work.

**1.2                REFERENCE STANDARDS**

- .1    American Society for Testing and Materials International (ASTM)
  - .1    ASTM D2564, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2    Canadian Standards Association International (CSA)
  - .1    CSA B1800, Thermoplastic Non-pressure Pipe Compendium.
- .3    Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1    Safety Data Sheets (SDS).
- .4    National Research Council Canada (NRC)
  - .1    NPC, National Plumbing Code of Canada.

**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.

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1    Deliver, store and handle in accordance with manufacturer's written instructions.
- .2    Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3    Store at temperatures and conditions recommended by manufacturer.
- .4    Dispose of waste materials in accordance with Section 01 74 21 - Waste Management and Disposal.

**Part 2            Products**

**2.1                PIPING AND FITTINGS**

- .1    For boilers condensate drainage piping and floor hub drainage piping:
  - .1    PVC-DWV with fire-retardant coating to CSA B1800.
  - .2    Flame spread rating of 25 or less and smoke developed of 50 or less, to CAN/ULC S102.2.

**2.2 JOINTS**

- .1 Solvent weld for PVC: to ASTM D2564.

**2.3 MECHANICAL JOINTS**

- .1 Flexible PVC
- .2 Min/max. operating temperature: -30/140 deg. F
- .3 Maximum Pressure: 4.3 PSI (29.6 kPa)
- .4 Acceptable Product: Fernco Inc. or approved equivalent in accordance with B7

**2.4 FUNNEL FLOOR DRAINS**

- .1 "TYPE E" round adjustable strainer top with combination funnel/grate with perimeter openings, polished bronze top.
- .2 Acceptable product: ZURN ZB-Z400E or approved equivalent in accordance with B7.

**Part 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 05 - Installation of Pipework.
- .2 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.

**3.3 TESTING**

- .1 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 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .3 Affix applicable label (storm, sanitary, vent, pump discharge) complete with directional arrows every floor or 4.5 m (whichever is less).

**3.5 CLEANING**

- .1 Proceed with cleaning in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Upon completion remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1            General**

**1.1                SUBMITTALS**

- .1        Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Shop drawings; where required, submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
- .3        Shop drawings to show:
  - .1        Mounting arrangements.
  - .2        Operating and maintenance clearances.
- .4        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.
- .5        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.
- .6        Closeout Submittals:
  - .1        Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2        Operation and maintenance manual approved by, and final copies deposited with Contract Administrator before final inspection.
  - .3        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.
  - .4        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.
  - .5        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.

- .6 Approvals:
  - .1 Submit 1 copy 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.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 Contract Administrator will provide 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.
- .9 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.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

## **1.2 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

## **1.3 MAINTENANCE**

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One gasket set for each heat exchanger.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

**Part 2 Products (Not Used)**

**Part 3 Execution**

**3.1 PAINTING REPAIRS AND RESTORATION**

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

**3.2 CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

**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 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:
  - .1 Heating, Ventilation and Air Conditioning (HVAC) 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 may record these demonstrations on video tape for future reference.

**3.5 PROTECTION**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

**END OF SECTION**

**Part 1 General**

**1.1 SCOPE OF WORK**

- .1 Section includes:
  - .1 Installation of natural gas, hydronic hot water and relief blowdown piping systems for new boilers.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME B31.3-22, Process Piping
- .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 CAN/CSA B149.1:20, Natural Gas and Propane Installation Code.
- .4 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.
- .5 National Fire Code of Canada (NFCC 2005)
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
  - .2 SCAQMD Rule 1168-A2005, 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, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

**Part 2 Products**

**2.1 MATERIAL**

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
  - .1 Primers, paints and coatings: in accordance with manufacturer's recommendations for surface conditions.

**Part 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 related codes.
- .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 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.

### **3.6 PIPEWORK INSTALLATION**

- .1 Install natural gas pipework to CSA B149.
- .2 Install hydronic system hot water pipework and relief blowdown pipework to ASME B31.3.
- .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, and 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.

### **3.7 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 firestopping.
    - .2 Maintain fire rating integrity.
  - .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.

### **3.8 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.

**3.9 PREPARATION FOR FIRE STOPPING**

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

**3.10 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant mechanical sections.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

**3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Contract Administrator 48 hours minimum prior to performance of pressure tests.
- .2 Piping: test as specified in relevant sections of heating, ventilating and air conditioning Work.
- .3 Maintain specified test pressure without loss for 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 as indicated.
- .2 Be responsible for damage to existing equipment by this Work.

**END OF SECTION**

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**Part 1            General**

**1.1            SCOPE OF WORK**

- .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 23. Refer to Division 26 for quality of materials and workmanship.

**1.2            REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 90.1-01, 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 Material Safety Data Sheets (MSDS).

**1.3            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.
- .3 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 regulations.

**1.5            DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

**Part 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 (1/2 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 373 W (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 208 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 (10 HP): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 Correct size of sheave determined during commissioning.
- .5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .6 Motor slide rail adjustment plates to allow for centre line adjustment.
- .7 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.

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**Part 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 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**

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**Part 1 GENERAL**

**1.1 SCOPE OF WORK**

- .1 Section includes:
  - .1 Welding of hydronic hot water piping and relief blowdown piping for new boilers.

**1.2 REFERENCE STANDARDS**

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.3-22, Process Piping.
  - .2 ANSI/ASME Boiler and Pressure Vessel Code-07:
    - .1 BPVC 2007 Section I: Power Boilers.
    - .2 BPVC 2007 Section V: Non-destructive Examination.
    - .3 BPVC 2007 Section IX: Welding and Brazing Qualifications.
- .2 American Welding Society (AWS)
  - .1 AWS C1.1M/C1.1-[2000(R2006)], Recommended Practices for Resistance Welding.
  - .2 AWS Z49.1-[2005], Safety in Welding, Cutting and Allied Process.
  - .3 AWS W1-[2000], Welding Inspection Handbook..
- .3 CSA Group (CSA)
  - .1 CSA W48-[06], Filler Metals and Allied Materials for Metal Arc Welding.
  - .2 CSA B51-[03(R2007)], Boiler, Pressure Vessel and Pressure Piping Code.
  - .3 CSA-W117.2-[2006], Safety in Welding, Cutting and Allied Processes.
  - .4 CSA W178.1-[2008], Certification of Welding Inspection Organizations.
  - .5 CSA W178.2-[2008], Certification of Welding Inspectors.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Welders:
    - .1 Welding qualifications in accordance with CSA B51.
    - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
    - .3 Submit welder's qualifications to Contract Administrator.
    - .4 Each welder to possess identification symbol issued by authority having jurisdiction.
    - .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
  - .2 Inspectors:
    - .1 Inspectors qualified to CSA W178.2.

- .3 Certifications:
  - .1 Registration of welding procedures in accordance with CSA B51.
  - .2 Copy of welding procedures available for inspection.
  - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

## **Part 2 PRODUCTS**

### **2.1 ELECTRODES**

- .1 Electrodes: in accordance with CSA W48 Series

## **Part 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 QUALITY OF WORK**

- .1 Welding: in accordance with ANSI/ASME B31.3, using procedures conforming to AWS B3.0, AWS C1.1, and applicable requirements of provincial authority having jurisdiction.

### **3.3 INSTALLATION REQUIREMENTS**

- .1 Identify each weld with welder's identification symbol.
- .2 Fittings:
  - .1 NPS 2 and smaller: install welding type sockets.
  - .2 Branch connections: install welding tees or forged branch outlet fittings.

### **3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS**

- .1 Review weld quality requirements and defect limits of applicable codes and standards with Contract Administrator before Work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Contract Administrator.
- .3 Do not conceal welds until they have been inspected, tested, and approved by inspector.
- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

### **3.5 SPECIALIST EXAMINATIONS AND TESTS**

- .1 General:
  - .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Contract Administrator.
  - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

- .3 Inspect and test 5 % of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") tests and radiographic tests.
- .2 Hydrostatically test welds to ANSI/ASME B31.3.
- .3 Visual examinations: include entire circumference of weld externally and wherever possible internally.
- .4 Failure of visual examinations:
  - .1 Upon failure of welds by visual examination, perform additional testing as directed by Contract Administrator of total of up to 10 % of welds, selected at random by Contract Administrator.
- .5 Full radiographic tests for hot water piping systems.
  - .1 Radiographic film:
    - .1 Identify each radiographic film with date, location, name of welder, and submit to Contract Administrator. Replace film if rejected because of poor quality.
  - .2 Interpretation of radiographic films:
    - .1 By qualified radiographer.
  - .3 Failure of radiographic tests:
    - .1 Extend tests to welds by welder responsible when those welds fail tests.
- .6 Magnetic particle tests for hot water piping systems.

### **3.6 DEFECTS CAUSING REJECTION**

- .1 As described in ANSI/ASME B31.3 and ANSI/ASME Boiler and Pressure Vessels Code

### **3.7 REPAIR OF WELDS WHICH FAILED TESTS**

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

**END OF SECTION**

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**Part 1            General**

**1.1                SCOPE OF WORK**

- .1    Section includes:
  - .1        Materials and installation for pressure gauges for piping systems.

**1.2                REFERENCES**

- .1    American Society of Mechanical Engineers (ASME)
  - .1        ASME B40.100-2005, Pressure Gauges and Gauge Attachments.
  - .2        ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.
- .2    Canadian General Standards Board (CGSB)
  - .1        CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
  - .2        CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

**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 thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.

**Part 2            Products**

**2.1                GENERAL**

- .1    Design point to be at mid-point of scale or range.
- .2    Range: 0-1100 kPa for hot water piping.

**2.2                DIRECT READING THERMOMETERS**

- .1    Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB-14.4.
  - .1        Resistance to shock and vibration.

**2.3                THERMOMETER WELLS**

- .1    Copper pipe: copper or bronze.
- .2    Steel pipe: brass or stainless steel.

**2.4                PRESSURE GAUGES**

- .1    Dial type: to ASME B40.100, Grade 2A, liquid filled, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified. Sizes: 75mm, 100mm.
- .2    Provide:
  - .1        Snubber for pulsating operation.
  - .2        Diaphragm assembly for corrosive service.

- .3 Gasketted pressure relief back with solid front.
- .4 Bronze stop cock.

### **Part 3 Execution**

#### **3.1 GENERAL**

- .1 Install thermometers and gauges so they can be easily read from floor or platform.
  - .1 If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

#### **3.2 THERMOMETERS**

- .1 Install in wells on piping. Include heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
  - .1 Heat exchangers.
  - .2 Water boilers.
  - .3 DHW tanks.
  - .4 Heat Pumps
- .3 Install wells for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

#### **3.3 PRESSURE GAUGES**

- .1 Install in locations as follows:
  - .1 Suction and discharge of pumps.
  - .2 Upstream and downstream of PRV's.
  - .3 Inlet and outlet of liquid side of heat exchangers.
  - .4 Outlet of boilers.
  - .5 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

#### **3.4 NAMEPLATES**

- .1 Install engraved lamicaid nameplates in accordance with Section 23 05 53.01 - Mechanical Identification, identifying medium.

**END OF SECTION**

**Part 1 General**

**1.1 SCOPE OF WORK**

- .1 Section includes:
  - .1 Materials and installation for hydronic system pipe supports.

**1.2 RELATED SECTIONS**

- .1 01 33 00 - Submittal Procedures
- .2 01 78 00 - Closeout Submittals.
- .3 Mechanical drawings.

**1.3 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B31.3-22, Process Piping.
- .2 ASTM International
  - .1 ASTM A125-1996(2007), Standard Specification for Steel Springs, Helical, Heat Treated.
  - .2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriter's Laboratories of Canada (ULC)

**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 data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit shop drawings for:
    - .1 Bases, hangers and supports.
    - .2 Connections to equipment and structure.
    - .3 Structural assemblies.
- .3 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Manufacturers' Instructions:

- .1 Provide manufacturer's installation instructions.

## 1.5 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 Closeout Submittals.

## 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

## Part 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 B31.3 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.

### 2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.3 and MSS SP58.
- .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 after manufacture.
  - .2 Use hot dipped galvanizing process.
  - .3 Ensure steel hangers in contact with copper piping are copper plated.
- .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: 13 mm FM approved.
  - .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.
- .6 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports to suit O.D. of pipe insulation.
- .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 two nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: black.
  - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated.
- .10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

## **2.4 RISER CLAMPS**

- .1 Steel or cast iron pipe: black carbon steel to MSS SP58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

## **2.5 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 164 kg/m<sup>3</sup> 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.

## **2.6 CONSTANT SUPPORT SPRING HANGERS**

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

## **2.7 VARIABLE SUPPORT SPRING HANGERS**

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with two springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

## **2.8 EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

## **2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

- .1 Provide templates to ensure accurate location of anchor bolts.

## **2.10 HOUSE-KEEPING PADS**

- .1 Where shown on drawings, provide 150 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

## **Part 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 Canadian Plumbing Code and authority having jurisdiction.
- .2 Copper piping: up to NPS 1/2: every 1.5 m.
- .3 Steel piping in water service: in accordance with table below. Table listings for straight runs without concentrated loads and where full linear movement is not required. Flexible joint roll grooved pipe shall also have support at joints.

Maximum Pipe Size : NPS	Maximum Spacing Steel
½ to 1	2.4 m
1 ½ to 2	3.0 m
3	3.7 m
4	4.3 m
6	5.2 m
8 to 10	6.0 m
12	7.0 m

- .4 Pipework greater than NPS 12: to MSS SP69.
- .5 Support piping within 300 mm of concentrated load, such as elbow, tee, valve or other inline component.

### 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 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1            General**

**1.1            SCOPE OF WORK**

.1            Section Includes:

- .1            Materials and requirements for the identification of new equipment, piping systems, ductwork, valves and controllers, including the installation and location of identification systems.

**1.2            RELATED SECTIONS:**

- .1            01 33 00 - Submittal Procedures
- .2            01 74 11 - Cleaning.

**1.3            REFERENCES**

.1            Canadian Gas Association (CGA)

- .1            CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.

.2            Canadian General Standards Board (CGSB)

- .1            CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
- .2            CAN/CGSB-24.3-92, Identification of Piping Systems.

.3            National Fire Protection Association (NFPA)

- .1            NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
- .2            NFPA 14-2003, Standard for the Installation of Standpipe and Hose Systems.

**1.4            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.

**1.5            QUALITY ASSURANCE**

.1            Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

**1.6            DELIVERY, STORAGE, AND HANDLING**

.1            Packing, shipping, handling and unloading:

- .1            Deliver, store and handle materials in accordance with manufacturer's written instructions.

**Part 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 (except where required otherwise by applicable codes).
- .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 in Mechanical Rooms: use size # 9.

**2.3 EXISTING IDENTIFICATION SYSTEMS**

- .1 N/A

**2.4 PIPING SYSTEMS GOVERNED BY CODES**

- .1 Identification:
  - .1 Natural gas: to CSA/CGA B149.1.
  - .2 Propane gas: to CSA/CGA B149.1.
  - .3 Sprinklers: to NFPA 13.
  - .4 Standpipe and hose systems: to NFPA 14.

**2.5 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 degrees C and intermittent temperature of 200 degrees C.
- .7 Colours and Legends:
  - .1 Where not listed, obtain direction from Contract Administrator.
  - .2 Colours for legends, arrows: to following table:

<b>Background colour:</b>	<b>Legend, arrows:</b>
Yellow	BLACK
White	BLACK

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
** Add design temperature		
++ Add design temperature and pressure		
Hot Water Heating Supply	White	HWS
Hot Water Heating Return	White	HWR
Glycol Heating Supply	White	GHS
Glycol Heating Return	White	GHR
Natural Gas	Yellow (Paint entire pipe according to codes)	

**2.6 IDENTIFICATION DUCTWORK SYSTEMS**

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

**2.7 VALVES, CONTROLLERS**

.1 Brass tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

**2.8 CONTROLS COMPONENTS IDENTIFICATION**

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

**2.9 EQUIPMENT**

.1 Identify all equipment with specified tags as indicated on drawings.

**2.10 LANGUAGE**

.1 Identification in English.

**Part 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 Perform Work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC or CSA registration plates as required by respective agency.

**3.3 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.

**3.4 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.

**3.5 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.

**3.6 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**

**Part 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                SCOPE OF WORK**

- .1        TAB of new boilers and associated hot water circulating pumps.
- .2        Coordinate Work with all applicable sections including section 23 09 33 Electric and Electronic Control for HVAC

**1.3                QUALIFICATIONS OF TAB PERSONNEL**

- .1        Submit names of personnel to perform TAB to Contract Administrator within 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-1-2002.
  - .2        National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
  - .3        Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .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.
- .9        For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist. 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.

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**1.4 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.

**1.5 EXCEPTIONS**

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

**1.6 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.

**1.7 PRE-TAB REVIEW**

- .1 Review contract documents before project construction is started and confirm in writing to 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 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.

**1.8 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.

**1.9 OPERATION OF SYSTEMS DURING TAB**

- .1 Operate systems for length of time required for TAB and as required by Contract Administrator for verification of TAB reports.

**1.10 START OF TAB**

- .1 Notify Contract Administrator 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 Filters in place, clean.
    - .2 Duct systems clean.
    - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
    - .4 Correct fan rotation.
    - .5 Fire, smoke, volume control dampers installed and open.
    - .6 Coil fins combed, clean.
    - .7 Access doors, installed, closed.
    - .8 Outlets installed; volume control dampers open.
  - .3 Liquid systems:
    - .1 Flushed, filled, vented.
    - .2 Correct pump rotation.
    - .3 Strainers in place, baskets clean.
    - .4 Isolating and balancing valves installed, open.
    - .5 Calibrated balancing valves installed, at factory settings.
    - .6 Chemical treatment systems complete, operational.

**1.11 APPLICATION TOLERANCES**

- .1 Do TAB to following tolerances of design values:
  - .1 HVAC systems: plus 5 %, minus 5%.
  - .2 Hydronic systems: plus or minus 10 %.

**1.12 ACCURACY TOLERANCES**

- .1 Measured values accurate to within plus or minus 2% of actual values.

**1.13 INSTRUMENTS**

- .1 Prior to TAB, submit to 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 3 months of TAB. Provide certificate of calibration to Contract Administrator.

**1.14 SUBMITTALS**

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

**1.15 PRELIMINARY TAB REPORT**

- .1 Submit for checking and approval of 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.

**1.16 TAB REPORT**

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit one copies of TAB Report to Contract Administrator for verification and approval, in English in electronic (PDF) format.

**1.17 VERIFICATION**

- .1 Reported results subject to verification by 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 Contract Administrator.
- .4 Pay costs to repeat TAB as required to satisfaction of Contract Administrator.

**1.18 SETTINGS**

- .1 After TAB is completed to satisfaction of 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.

**1.19 COMPLETION OF TAB**

- .1 TAB considered complete when final TAB Report received and approved by Contract Administrator.

**1.20 AIR SYSTEMS**

- .1 Standard: TAB to most stringent of TAB standards of AABC.  
Do TAB of systems, equipment, components, controls specified Division 23.
- .2 Qualifications: personnel performing TAB current member in good standing of AABC.
- .3 Quality assurance: perform TAB under direction of supervisor qualified by AABC.
- .4 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.
- .5 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.
- .6 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

**1.21 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.
- .2 Smoke management systems:
  - .1 Test for proper operation of all smoke and fire dampers, sensors, detectors installed as component parts of air systems specified Division 23.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not used.

**END OF SECTION**

**Part 1            General**

**1.1                SCOPE OF WORK**

- .1        Section includes:
  - .1        Duct insulation for boilers combustion air intake.

**1.2                RELATED SECTIONS**

- .1        01 33 00 - Submittal Procedures
- .2        01 74 11 – Cleaning
- .3        23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

**1.3                REFERENCES**

- .1        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.
- .2        Reference Standards:
  - .1        American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    - .1        ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .2        ASTM International Inc.
    - .1        ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
    - .2        ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
    - .3        ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - .4        ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .5        ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
    - .6        ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - .7        ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
    - .8        ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
    - .9        ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .3        Canadian General Standards Board (CGSB)
    - .1        CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

- .4 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-36-00, Commercial Adhesives.
- .5 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .7 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

#### **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 Manufacturers' Instructions:
  - .1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, and cleaning procedures.

#### **1.5 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: specialist in performing Work of this section, and have at least 3 years successful experience in this size and type of project.

#### **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

### **Part 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 degrees 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 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire-retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: compatible with insulation.
- .3 Aluminum (to be used on all outdoor ductwork):
  - .1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.
  - .2 Thickness: 0.81 mm sheet.
  - .3 Finish: corrugated.
  - .4 Jacket banding and mechanical seals: 12 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.
- .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 ULC Listed Canvas Jacket:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5 Outdoor Vapour Retarder Mastic:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
  - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.
- .6 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .11 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

## **Part 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 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 2 rows each side.

**3.4 DUCTWORK INSULATION SCHEDULE**

- .1 Insulation types and thicknesses: conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular and round ducts outside	C-1	yes	50

- .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	
	Rectangular	Round
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4

**3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1 General**

**1.1 SCOPE OF WORK**

.1 Section Includes:

.1 Insulation for new hot water piping, including any modified existing lines.

**1.2 RELATED SECTIONS**

.1 01 33 00 - Submittal Procedures

.2 01 74 11 - Cleaning.

**1.3 REFERENCES**

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.

.2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547-2003, Mineral Fiber Pipe Insulation.

.7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing 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 Material Safety Data Sheets (MSDS).

- .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-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
  - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

#### **1.4 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.

#### **1.5 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.
- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 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.

#### **1.6 QUALITY ASSURANCE**

- .1 Qualifications:
- .2 Installer: specialist in performing Work of this Section, and have at least 3 years successful experience in this size and type of project.

#### **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.

## **Part 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 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702.
  - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 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.
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to CAN/ULC-S702.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702.
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
  - .1 Insulation: with vapour retarder jacket.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702.
  - .4 Certified by manufacturer: free of potential stress corrosion cracking corrodents.
- .7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
  - .1 Insulation: to ASTM C533.
  - .2 Maximum "k" factor: to CAN/ULC-S702.
  - .3 Design to permit periodic removal and re-installation.

### **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, 19mm wide, 0.5 mm thick.

### **2.4 CEMENT**

- .1 Thermal insulating and finishing cement:
  - .1 Hydraulic setting on mineral wool, to ASTM C449/C449M.

### **2.5 VAPOUR RETARDER LAP ADHESIVE**

- .1 Water based, fire retardant type, compatible with insulation.

### **2.6 INDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.

### **2.7 OUTDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m<sup>2</sup>.

### **2.8 JACKETS**

- .1 **Indoor:** Canvas jacket to match existing piping:
  - .1 Colours: to match adjacent finish paint.

## **Part 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 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 expansion joints, valves, flanges and unions at equipment.
- .2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
  - .1 Insulation, fastenings and finishes: same as system.
  - .2 Jacket: canvas.

**3.5 INSTALLATION OF ELASTOMERIC INSULATION**

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

**3.6 PIPING INSULATION SCHEDULES**

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 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 degrees 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
Hot Water Piping	60 - 121	A-1	25	38	38	38	38	38

- .3 Finishes:
  - .1 Exposed indoors: canvas jacket.
  - .2 Exposed in mechanical rooms: canvas.
  - .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 Outdoors: water-proof aluminum jacket.
- .6 Finish attachments: SS bands, at 150 mm on centre.
- .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

**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**

**Part 1 General**

**1.1 Scope of Work**

.1 Section includes:

- .1 Performance verification of new boilers and associated circulating pumps, natural gas supply, and new drainage plumbing on Boiler 5 room.

**1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS**

.1 In accordance with Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems.

**1.3 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)**

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 When systems are operational, perform following tests:

- .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
- .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures and temperatures.

**1.4 HYDRONIC SYSTEM CAPACITY TEST**

.1 Perform hydronic system capacity tests after:

- .1 TAB has been completed
- .2 Verification of operating, limit, safety controls.
- .3 Verification of primary and secondary pump flow rates.
- .4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Calculate system capacity at test conditions.

.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Heating system capacity test:

- .1 Perform capacity test when ambient temperature is within 10% of design conditions.
- .2 Test procedures:
  - .1 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
  - .2 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

**1.5 GASEOUS FUEL SYSTEMS**

.1 Operation tests:

- .1 Measure gas pressure at gas metre outlet and at burner manifold.

- .2 Verify details of temperature and pressure compensation at meter.
- .3 Verify settings, operation, venting of high and low pressure cut-outs, alarms.
- .4 Check terminals of vents for gas pressure regulators.

**1.6 SANITARY AND STORM DRAINAGE SYSTEMS**

- .1 Buried systems: perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

**1.7 REPORTS**

- .1 In accordance with Section 01 91 13 - General Commissioning Requirements: Reports, supplemented as specified herein.

**1.8 TRAINING**

- .1 In accordance with Section 01 91 13 - General Commissioning Requirements: Training of O&M Personnel, supplemented as specified herein.
  - .1 Include following:
    - .1 Boilers and hot water circulating pumps.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                SCOPE OF WORK**

- .1    Section Includes:
  - .1        Procedures for cleaning mechanical piping systems.

**1.2                REFERENCE STANDARDS**

- .1    Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1        Safety Data Sheets (SDS).

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1    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.
  - .2        Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
    - .1            Instructions: submit manufacturer's installation instructions.

**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    Packing, shipping, handling and unloading:
  - .1        Deliver, store and handle in accordance with manufacturer's written instructions.
- .2    Waste Management and Disposal:
  - .1        Waste Management and Disposal: separate waste materials for reuse and recycling in accordance local standards.

**Part 2            Products**

- .1    Not used.

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**Part 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 CLEANING HYDRONIC SYSTEMS**

- .1 Perform mechanical cleaning to remove welding slag
- .2 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .3 Cleaning Agency:
  - .1 Retain qualified water treatment specialist to perform system cleaning.
- .4 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete [by water treatment specialist].
- .5 Cleaning procedures:
  - .1 Provide detailed report outlining proposed cleaning procedures prior to hot water piping installation. Report to include:
    - .1 Cleaning procedures to remove welding slag, construction debris, dirt, and any other foreign materials from hot water pipe spools prior to installation.
    - .2 Inspection procedures to verify cleanliness of complete interior of piping prior to installation.
    - .3 Special precautions for protecting piping system materials and components. Temporary startup strainers shall be provided on inlet piping to boilers.
  - .2 Cleaning and inspection of piping shall be performed to the satisfaction of the Contract Administrator.

**3.3 START-UP OF HYDRONIC SYSTEMS**

- .1 Provide plan for system filling using make-up from existing boiler hot water system for review. Following approval from Contract Administrator:
  - .1 Fill new piping from existing boiler hot water system.
  - .2 Establish circulation.
  - .3 Ensure air is removed.
  - .4 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
  - .5 Clean out startup strainers repeatedly until clean.
  - .6 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .7 Adjust pipe supports, hangers, springs as necessary.
  - .8 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
  - .9 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

- .10 Check operation of drain valves.
- .11 Adjust valve stem packings as systems settle down.
- .12 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

**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**

**Part 1            General**

**1.1                SCOPE OF WORK**

- .1 Section Includes:
  - .1 Materials and installation for natural gas piping, valves and fittings for gas fired equipment.

**1.2                REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
  - .2 ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
  - .4 ASME B18.2.1-96, Square and Hex Bolts and Screws Inch Series.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .3 ASTM B75M-99, Standard Specification for Seamless Copper Tube Metric.
  - .4 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
  - .1 CAN/CSA B149.1:20, Natural Gas and Propane Installation Code.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**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 for piping, fittings and equipment.
- .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions: submit manufacturer's installation instructions.

- .5 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**Part 2 Products**

**2.1 PIPE**

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
  - .1 NPS 1/2 to 2, screwed.
  - .2 NPS 2 1/2 and over, plain end.

**2.2 JOINTING MATERIAL**

- .1 Screwed fittings: joint sealant to CAN/ULC-S642.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.

**2.3 FITTINGS**

- .1 Steel pipe fittings, screwed, flanged or welded:
  - .1 Malleable iron: screwed, banded, Class 150.
  - .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
  - .3 Welding: butt-welding fittings.
  - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
  - .5 Bolts and nuts: to ASME B18.2.1.
  - .6 Nipples: schedule 40, to ASTM A53/A53M.

**2.4 VALVES**

- .1 Provincial Code approved, ball or lubricated plug type.

**2.5 PRESSURE REDUCING REGULATORS**

- .1 Pressure reducing regulator for each boiler:
  - .1 Cast iron body
  - .2 Sized for boiler natural gas input 1,759 kW (6,000,000 Btu/h)
  - .3 Operating pressures: 35 kPa (5 psi) inlet, 1.7 kPa (7 inches W.C.) outlet
  - .4 High-capacity internal relief
  - .5 Size: DN 50 (2" NPS)
  - .6 Connections: NPT
  - .7 Acceptable Product: Fisher Type CS800IQ or approved equal.

**Part 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 PIPING**

- .1 Fabricate, install, examine and test in accordance with Section 23 05 05 - Installation of Pipework, CAN/CSA B149, and applicable Provincial Codes, supplemented as specified.
- .2 Install drip points:
  - .1 At low points in piping system.
  - .2 At connections to equipment.
- .3 Prime and paint gas piping safety yellow.

**3.3 VALVES**

- .1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

**3.4 PRESSURE REDUCING REGULATORS**

- .1 Install pressure reducing regulator for each boiler.

**3.5 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Test system in accordance with CAN/CSA B149 and requirements of authorities having jurisdiction.
- .2 Manufacturer's Field Services:
  - .1 Have manufacturer of products supplied under this Section review Work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of Work with Contract.
  - .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 at stages listed:
    - .1 Upon completion of Work, after cleaning is carried out.
- .3 Obtain reports within 3 days of review and submit immediately to Departmental Representative.
- .4 PV procedures:
  - .1 Test performance of components.

**3.6 ADJUSTING**

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.
- .2 Pre-Start-Up Inspections:
  - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
  - .2 Check gas trains, entire installation is approved by authority having jurisdiction.

**3.7 CLEANING**

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**Part 1            General**

**1.1            SCOPE OF WORK**

- .1    Section includes:
  - .1    Materials and installation for steel piping, valves and fittings for new boilers hot water and relief blowdown systems.

**1.2            RELATED SECTIONS**

- .1    Section 01 33 00 - Submittal Procedures.
- .2    Section 01 78 00 - Closeout Submittals.
- .3    Section 23 05 17 - Pipe Welding.
- .4    Section 23 08 16 - Cleaning and Start-up of Mechanical Piping Systems.
- .5    Section 23 05 05 - Installation of Pipework.
- .6    Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .7    Section 23 08 13 - Performance Verification of Mechanical Piping.

**1.3            REFERENCES**

- .1    American Society of Mechanical Engineers (ASME).
  - .1    ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.
  - .2    ASME B16.3-98, Malleable Iron Threaded Fittings.
  - .3    ASME B16.5-03, Pipe Flanges and Flanged Fittings.
  - .4    ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.
  - .5    ASME B16.34-20, Valves – Flanged, Threaded, and Welding End
  - .6    ASME B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).
  - .7    ASME B18.2.2-87(R1999), Square and Hex Nuts (Inch Series).
  - .8    ASME B31.3-22, Process Piping
- .2    American Society for Testing and Materials International, (ASTM).
  - .1    ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.
  - .2    ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - .3    ASTM A536-84(1999)e1, Standard Specification for Ductile Iron Castings.
  - .4    ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings.
  - .5    ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .6    ASTM E202-00, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .3    American Water Works Association (AWWA).
  - .1    AWWA C111-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4    Canadian Standards Association (CSA International).

- .1 CSA B242-M1980(R1998), Groove and Shoulder Type Mechanical Pipe Couplings.
- .2 CAN/CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-67-025, Butterfly Valves.
  - .2 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.
  - .4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
  - .5 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

#### 1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### 1.5 MAINTENANCE

- .1 Extra Materials.
  - .1 Provide following spare parts:
    - .1 Valve seats: one for every ten valves, each size. Minimum one.
    - .2 Discs: one for every ten valves, each size. Minimum one.
    - .3 Stem packing: one for every ten valves, each size. Minimum one.
    - .4 Valve handles: two of each size.
    - .5 Gaskets for flanges: one for every ten flanges.

### Part 2 Products

#### 2.1 DESIGN CONDITIONS

- .1 All materials used in hydronic systems piping shall be rated for minimum 1100 kPa (160 psi) at 121 °C (250 °F).

#### 2.2 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
  - .1 NPS ½ to 2: Schedule 80.
  - .2 To NPS 10: Schedule 40.

#### 2.3 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with Teflon tape.
- .2 NPS 2 1/2 and over: welding fittings and flanges to CSAW47.1 and CSA W47.1S1.
- .3 Roll grooved (use only where indicated on drawings): standard coupling to CSA B242, two ductile iron housings, elastomer pressure responsive gasket, and ASTM A449 compliant bolts and nuts.
  - .1 Rigid Type: Housings cast with torque-absorber and shift-limiting slant bolt pad design to provide piping system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9, and to prevent mis-assembly due to overshift.

Housings cast with alignment indicator notch for visual proper alignment to adjoining fitting. Installation-Ready™, for direct stab installation without field disassembly, with center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth.

- .2 Acceptable material: Victaulic Style 107V or approved equivalent in accordance with B7.
- .4 Flanges: raised face, weld neck, forged steel ASTM A105N, ANSI B16.5 Class 150.
- .5 Flange gaskets: to ANSI/AWWA C111/A21.11.
- .6 Bolts and nuts: to ANSI B18.2.1 and ANSI/ASME B18.2.2.
- .7 Pipe thread: taper.

## 2.4 FITTINGS

- .1 Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
  - .1 Steel: to ANSI/ASME B16.5.
- .3 Unions: malleable iron, to ASTM A47M and ANSI/ASME B16.3.
- .4 Butt - welding fittings: steel, to ANSI/ASME B16.9.
- .5 Fittings for roll grooved piping (use only where indicated on drawings): ductile iron to ASTM A536 or factory manufactured from ASTM A53 steel pipe.
  - .1 NPS 2 through NPS 12; ASTM A536 Grade 65-45-12 ductile iron with grooved ends, stiffening ribs, and alignment indicators, orange coated or hot dipped galvanized as per ASTM A123, working pressure 2758 kPa (400 psi).
  - .2 Acceptable material: Victaulic QuickVic™ 10 (90-deg), 11 (45-deg), and 20 (tee) or approved equivalent in accordance with B7.

## 2.5 VALVES

- .1 Connections:
  - .1 NPS 2 and smaller: NPT ends.
  - .2 NPS 2 ½ and larger: flanged ends.
- .2 Ball Valves:
  - .1 NPS 2 and under:
    - .1 600 WOG, bronze body, NPT, TFE seal, hard chrome solid ball, Teflon seats and lever handle.
    - .2 Acceptable material: MAS B3, Red-White 5044A, or approved equivalent in accordance with B7.
- .3 Ball Valves, 3-Way:
  - .1 NPS 2 and under:
    - .1 400 WOG, reduced L-port, bronze body, NPT, TFE seal, hard chrome solid ball, Teflon seats and lever handle.
    - .2 Acceptable material: MAS B-3L, Red-White 5045A, or approved equivalent in accordance with B7.
- .4 Gate valves:
  - .1 NPS 2 and under:
    - .1 Non-rising stem, to MSS SP-80, Class 150, bronze body, NPT, solid wedge disc.

- .2 Acceptable material: Red-White 204A, Kitz 46 (AK150E), or approved equivalent in accordance with B7.
- .2 NPS 2 ½ and over:
  - .1 Class 150, API 600, OS & Y, bolted bonnet, A216 WCB cast steel body/bonnet, 13Cr wedge/disc surface, Stellite 6 seat surface, A182 stem, 316L/graphite gasket, flexible graphite packing, B7/2H bolting B16.5 flanged ends, ductile iron handwheel.
  - .2 Provide chainwheel operator for valves higher than 2.0 m above floor.
  - .3 Acceptable material: Kitz 150SCLS or approved equivalent in accordance with B7.
- .5 Balancing Valves:
  - .1 NPS 2 ½ and over:
    - .1 Pressure-temperature rating minimum 1100 kPa (160 psi) at 121 °C (250 °F).
    - .2 Class 150 flanged, Y-pattern globe style, ductile iron body, brass/copper alloy trim, EPDM O-ring seals.
    - .3 8, 12, 16, 20 or 22 turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections for portable differential pressure meter.
  - .2 Acceptable material: TA Series 788 or approved equivalent in accordance with B7.
- .6 Check Valves:
  - .1 NPS 2 and under:
    - .1 Class 150, NPT, MSS SP-80, Y-pattern swing type, bronze body and disc, integral seat
  - .2 Acceptable material: Kitz 29 (AK150YR) or approved equivalent in accordance with B7.
  - .3 NPS 2 ½ and over:
    - .1 Class 150, globe-style, spring-assist silent closing, A216 WCB steel body, stainless steel A351 CF8M trim, stainless steel spring.
  - .4 Acceptable material: Mueller Steam Specialty Model 105MDT or approved equivalent in accordance with B7.

### **Part 3 Execution**

#### **3.1 PIPING**

- .1 Fabricate, install, examine and test in accordance with Section 23 05 05 - Installation of Pipe Work, ASME B31.3, and applicable Provincial Codes, supplemented as specified.
- .2 Piping Contractor shall be qualified to perform pressure piping fabrication and installation under Provincial regulations.

#### **3.2 CIRCUIT BALANCING VALVES**

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and when TAB is complete.

**3.3 CLEANING, FLUSHING AND START-UP**

- .1 In accordance with Section 23 08 16 - Cleaning and Start-Up of Mechanical Piping Systems.

**3.4 TESTING**

- .1 Perform hydrostatic testing of hot water piping in accordance with ASME B31.3.

**3.5 BALANCING**

- .1 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

**3.6 PERFORMANCE VERIFICATION**

- .1 In accordance with Section 23 08 13 - Performance Verification of Mechanical Piping.

**END OF SECTION**

**Part 1 General**

**1.1 SCOPE OF WORK**

- .1 Installation and commissioning of boiler pump BP-5C (supplied by the City) as specified herein.
- .2 Supply, installation, and commissioning of low-flow pump BP-5D as specified herein.
- .3 Delivery lead time of the equipment shall not **exceed 3 weeks.**

**1.2 REFERENCES**

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers Advisory Council (EEMAC)
- .3 Canadian Standards Association (CSA International)
  - .1 CSA-B214-07, Installation Code for Hydronic Heating Systems.
- .4 National Electrical Manufacturers' Association (NEMA)
  - .1 NEMA MG 1-2006, Motors and Generators.

**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 pump, circulator, and equipment, and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.
- .3 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance and operation data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**1.5 MAINTENANCE**

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

**Part 2 Products**

**2.1 BOILER PUMP (BP-5C)**

- .1 Supplied by the City / Installed by Contractor, "Bell & Gossett" Series e-80 3x3x9.5C.
  - .1 Capacity: 22 L/s (349 usgpm) against total differential head of 21 m (69 ft.), 8.7 BHP at design.

- .2 Impeller: 241 mm (9.5").
- .3 Connections: DN 80 (3") flanged.
- .4 Motor: 7.5 kW (10 HP), 575/3/60, 1800 RPM, ODP with NEMA Premium Efficiency rating, motor shall be non-overloading at any point on the impeller curve.

## 2.2 LOW FLOW PUMP (BP-5D)

- .1 Capacity: 1.89 L/s (30 usgpm) against total differential head of 8.5 m (28 ft.) at design.
- .2 Fluid: Hot Water
- .3 Connections: flange to flange distance 162 mm (6 3/8").
- .4 Construction:
  - .1 Close coupled booster pump.
  - .2 The pumps shall be of the horizontal, permanently lubricated type, specifically designed and guaranteed for quiet operation.
  - .3 The pumps shall have a steel shaft supported by permanently lubricated, sealed precision ball bearings. The pumps are to be equipped with a water-tight seal to prevent leakage. Mechanical seal faces to be carbon on silicon carbide. The motor shall be non-overloading at any point on the pump performance curve.
  - .4 The motor shall be of the drip-proof, sealed precision ball-bearing, quiet-operating construction. The permanent split-capacitor motor shall be equipped with thermal overload protection.
  - .5 Pumps to be suitable for 225°F (107°C) operating temperature at 150 psig (1034 kPa) working pressure.
  - .6 Pump impeller: Glass Filled PPS
  - .7 Face plate: Stainless steel
  - .8 Booster body: Cast iron
  - .9 Shaft: Stainless Steel
- .5 Motor: 0.30 kW (0.4 HP), 115/3/60, 3250 RPM.
- .6 Acceptable product: "Bell & Gossett" Series PL-55 or approved equivalent in accordance with B7.

## Part 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 hydronic pumps to: CSA-B214.
- .2 In line circulators: install as indicated by flow arrows.
  - .1 Support at inlet and outlet flanges.
  - .2 Install with bearing lubrication points accessible.

- .3 Base mounted type: supply templates for anchor bolt placement.
  - .1 Include anchor bolts with sleeves. Place level, shim unit and grout.
  - .2 Align coupling in accordance with manufacturer's recommended tolerance.
- .4 Ensure that pump body does not support piping or equipment.
  - .1 Provide stanchions or hangers for this purpose.
  - .2 Refer to manufacturer's installation instructions for details.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install pressure gauge test cocks.

**3.3 START-UP**

- .1 General:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements; supplemented as specified herein.
  - .2 In accordance with manufacturer's recommendations.
- .2 Procedures:
  - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
  - .2 After starting pump, check for proper, safe operation.
  - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
  - .4 Check base for free-floating, no obstructions under base.
  - .5 Run-in pumps for 12 continuous hours minimum.
  - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
  - .7 Eliminate air from scroll casing.
  - .8 Adjust water flow rate through water-cooled bearings.
  - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
  - .10 Adjust alignment of piping and conduit to ensure true flexibility.
  - .11 Eliminate cavitation, flashing and air entrainment.
  - .12 Adjust pump shaft seals, stuffing boxes, glands.
  - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
  - .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
  - .15 Verify lubricating oil levels.

**END OF SECTION**

**Part 1 General**

**1.1 SCOPE OF WORK**

- .1 Section Includes:
  - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories for new boilers combustion air intake.
- .2 Related Sections:
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

**1.2 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .3 ASTM A653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .4 National Fire Protection Association (NFPA).
  - .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition [1995] and Addendum No. 1, 1997.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
  - .3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.

**1.3 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: for the following:
  - .1 Sealants.
  - .2 Tape.
  - .3 Proprietary Joints.

**1.4 QUALITY ASSURANCE**

- .1 Certification of Ratings:
  - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Protect on site stored or installed absorptive material from moisture damage.

**Part 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 A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
  - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.
  - .3 Class C: transverse joints and connections made air tight with sealant. Longitudinal seams unsealed.

**2.2 SEALANT**

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 40 degrees C to plus 93 degrees C.

**2.3 DUCT LEAKAGE**

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

**2.4 FITTINGS**

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
  - .1 Rectangular: standard radius or short radius with single thickness turning vanes. Centreline radius: 1.5 times width of duct.
  - .2 Round: smooth radius. Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
  - .1 To 400 mm: with single thickness turning vanes.
  - .2 Over 400 mm: with double thickness turning vanes.

- .4 Branches:
  - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45 degrees entry on branch.
  - .2 Round main and branch: enter main duct at 45 degrees.
  - .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.

**2.5 FIRE STOPPING**

- .1 Retaining angles around duct, on both sides of fire separation in accordance with standards.
- .2 Fire stopping material and installation must not distort duct.

**2.6 GALVANIZED STEEL**

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

**2.7 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 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 SMACNA and 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:

**Part 3 Execution**

**3.1 GENERAL**

- .1 Do work in accordance with SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .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 installation of acoustic duct lining.
- .7 Cover ductwork during construction to prevent dust accumulation.

**3.2 HANGERS**

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with SMACNA as follows:

Duct Size	Spacing
(mm)	(mm)
to 1500	3000
1501 and over	2500

**3.3 WATERTIGHT DUCT**

- .1 Provide watertight duct for:
  - .1 Fresh air intakes.
- .2 Form bottom of horizontal duct without longitudinal seams.
  - .1 Solder joints of bottom and side sheets.
  - .2 Seal other joints with duct sealer.

**3.4 SEALING AND TAPING**

- .1 Apply sealant to outside of joint to manufacturer's 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.

**END OF SECTION**

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**Part 1            General**

**1.1                SCOPE OF WORK**

- .1            Section includes:
  - .1            Materials and installation for new boilers combustion air intake.

**1.2                REFERENCE STANDARDS**

- .1            National Research Council Canada (NRC)
  - .1            National Building Code of Canada (NBC).
- .2            Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

**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 intakes and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2            Indicate following:
    - .1            Face area.
    - .2            Free area.
- .3            Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1            Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2            Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3            Storage and Handling Requirements:
  - .1            Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2            Replace defective or damaged materials with new.

**Part 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.

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## **2.2 GOOSENECK HOODS**

- .1 Thickness: to SMACNA.
- .2 Fabrication: to SMACNA.
- .3 Joints: to SMACNA.
- .4 Supports: as indicated.
- .5 Complete with integral birdscreen of 2.7 mm diameter SS wire. Use 19 mm mesh on intake.

## **2.3 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: 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: anodized. Colour: to Contract Administrator's approval.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for louvres, intakes and vents installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .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 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.

**3.3 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**

**Part 1 General**

**1.1 SCOPE OF WORK**

- .1 Section Includes:
  - .1 Heating boiler units:
    - .1 Supply, Delivery, Hoisting/Craning, Installation, and Commissioning.
    - .2 Provide on-site boiler start-up and commissioning by manufacturer.
    - .3 The boilers shall be rated for an operating temperature of **121°C.**
    - .4 Delivery lead time shall not **exceed 4 weeks.**
  - .2 Related Sections:
    - .1 01 33 00 - Submittal Procedures
    - .2 01 78 00 - Closeout Submittals
    - .3 01 74 11 - Cleaning.
    - .4 01 79 00 – Demonstration and Training

**1.2 REFERENCES**

- .1 American Boiler Manufacturer's Association (ABMA)
- .2 American National Standards Institute (ANSI)
  - .1 ANSI Z21.13-2004/CSA 4.9-2004, Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- .3 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)
  - .1 ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 2004.
- .4 Canadian Gas Association (CGA)
  - .1 CAN1-3.1-77(R2001), Industrial and Commercial Gas-Fired Package Boilers.
  - .2 CAN/CSA-B149.1-20, Natural Gas and Propane Installation Code.
- .5 Canadian Standards Association (CSA International)
  - .1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.
  - .2 CSA B139-04, Installation Code for Oil Burning Equipment.
  - .3 CSA B140.7-05, Oil Burning Equipment: Steam and Hot-Water Boilers.
- .6 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

- .1 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.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Indicate the following:

- .1 General arrangement showing terminal points, instrumentation test connections.
- .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
- .3 Foundations with loadings, anchor bolt arrangements.
- .4 Piping hook-ups.
- .5 Equipment electrical drawings.
- .6 All miscellaneous equipment.
- .3 Engineering data to include:
  - .1 Radiant heat loss at 100% design capacity.
- .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.
- .4 Closeout Submittals:
  - .1 Submit operation and maintenance data 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 applicable Provincial regulations.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions.
  - .2 Boilers may have to be lifted up to the roof and brought into the Penthouse Mechanical room. Contractor shall visit the site and determine how to bring up the boilers prior to tender closing and include all associated costs.
  - .3 Roof shall be protected with plywood when bringing in the boilers via roof.

#### **1.6 MAINTENANCE**

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Extra materials:
  - .1 Spare parts for 1 year of operation.

### **Part 2 Products**

#### **2.1 BOILERS B-5A, B-5B, and B-5C**

- .1 General:
  - .1 Packaged boiler:
    - .1 Complete with necessary accessories and controls.
    - .2 Ready for attachment to piping, electrical power, controls.
    - .3 Designed and constructed to ANSI/ASME Boiler and Pressure vessel Code.
    - .4 CRN (Canadian Registration Number), to CSA B51.

- .2 Controls: factory wired. Enclosed in Electrical and Electronic Manufacturers' Association of Canada (EEMAC) steel cabinet.
- .3 Accessories for each boiler: pressure relief valve set at 160 psig (1100 kPa), flow switch, low water cutoff.
- .4 Anchor bolts and templates:
  - .1 Supply for installation by other Divisions.
- .5 Start-up, instruction, on-site performance tests: 3 days per boiler.
- .6 Trial usage:
  - .1 Contract Administrator may use boilers for test purposes prior to acceptance and commencement of warranty period.
  - .2 Supply labour, materials and instruments required for tests.
- .7 Temporary use by contractor:
  - .1 Contractor may use boilers only after written approval from Contract Administrator.
  - .2 Monitor and record performance continuously. Keep log of maintenance activities carried out.
  - .3 Refurbish to as-new condition before final inspection and acceptance. Warranty shall remain as 1 year from acceptance (date of substantial completion).
- .2 Performance:
  - .1 6,000,000 Btu/h input, near-condensing (88% thermal efficiency)
- .3 Dimensions and Weights:
  - .1 Dimensions: 910mm (W) x 1,000mm (D) x 2,600mm (H) - (35 ¾" (W) x 39 ¼" (D) x 102" (H))
  - .2 Shipping Weight: 890 kg - (1,963 lbs)
- .4 Heat Exchanger:
  - .1 The heat exchanger shall be tested and inspected to ASME Section IV requirements. The ASME Section IV seal of approval will not be provided as standard for jurisdictions not requiring the ASME Section IV seal of approval. The heat exchanger shall be a four pass design with a maximum working pressure of 1100 kPa (160 psig) and a maximum allowed operating temperature of 121°C (250°F). The heat exchanger is of cylindrical design, with integral copper finned tubes 7/8" I.D., 0.064" minimum wall thickness, 7 fins per inch, with nominal fin height of 3/8". Each end of the tubes shall be expanded by mechanical rolling process into the headers. The heat exchanger shall be gasket-less. All header castings shall be bronze. Heat exchanger tubes shall be cupronickel alloy C70600.
- .5 Combustion Chamber:
  - .1 The combustion chamber shall be constructed of stainless steel, sealed water tight, chamber to be covered with minimal ¼" thick ceramic insulation. A stainless steel access door shall be provided for ease of service and inspection to the outer heat exchanger surface and an easily removable radial fired knitted fiber stainless steel burner to access the internal combustion chamber for inspection, service, and cleaning. A window view port shall be provided for visual inspection of the boiler combustion during firing.
- .6 Gas Train:
  - .1 The gas train shall consist of a pressure regulating electro-hydraulic proportional air/gas main gas actuator providing a slow opening, fast closing shutoff valve and proportional 1:1 air/gas ratio control, a fast closing safety shutoff gas solenoid,

and a low gas pressure switch. A factory pre-set combination metering valve and orifice shall be provided for setting combustion parameters. Turndown ratio 5:1.

.7 Burner/Combustion:

.1 The combustion air fan draws gas under negative pressure and mixes it with air to generate a fine-tuned air gas mixture which is delivered under positive pressure to the radial knitted stainless steel burner. Combustion modulation is established by a variable frequency drive. The burner shall be a 100% stainless steel vertical mounted radial fired type with stainless knitted metal fiber construction. The burner shall combust a precise amount of premixed combustion air and gas to provide equal distribution of heat for heat transfer throughout the entire heat exchanger. Combustion products are exhausted under minimum back pressure. Combustion operates with a 5:1 turn down ratio while sustaining combustion characteristics throughout the entire modulating range. Operation of up to 88% thermal efficiency and shall be certified for Oxides of Nitrogen (NOx) of 9 ppm corrected to 3% oxygen.

.8 Firing Mode:

.1 The burner combustion shall operate as proportional modulating with a 5:1 turndown ratio with a minimum 20% firing rate. Multiple boiler parallel sequential firing algorithms. Light off shall be at no more than 50% to ensure a rumble free soft start.

.9 Controls:

.1 Standard controls include a SOLA electronic proportional integrated combination ignition limit/operator control accurate to 1°F (0.5°C) having a 4-20 mA output signal suitable for control of a variable frequency motor drive for modulating fan speeds. Controls are lead lag "Cascade" ready for control of up to eight boilers c/w Indoor outdoor reset. Control shall be equipped and ready with 4-20 mA or 0-10Vdc input for remote set point or modulating control. Control is BMS Modbus RTU protocol ready and capable of other alternate protocol conversions with additional optional gateway protocol converter. Control shall be supplied with a 7" mounted touch screen display which shall also provide for control system configuration and set up, readouts of boiler target, differential and inlet/outlet temperatures as well as accumulated runtime, enunciator diagnostics, real time data logging and firing rates. The complete control package shall be mounted on the front panel with a hinged door for easy access to all control modules. The boiler safety control string shall be furnished with controls for low gas pressure, fan air proving, blocked flue, high limit and flow switch. High gas pressure switch is standard on CSD1 equipped boilers and is standard on models 3001 and up. A flow switch, relief valve and low water cutoff shall be provided for each unit. Additional control safeties shall include flame rectification, fan speed, and auto recycling high limit.

.10 Ignition Module:

.1 The ignition module shall employ a direct igniter with 3 tries for ignition followed by a 90 minute standby and repeat of 3 tries for ignition for models DF 501 - DF 2501. A proven pilot is used on models DF 501 – DF 6014. Trial for ignition shall proceed with 15 seconds between retrievals. Ignition control shall include times for pre-purge, pre-ignition, ignition, and post purge.

.11 External Jacket and Fasteners:

.1 The external jacket shall be of 430 stainless steel mirror finish panels and a powder paint coated access top cover assembled utilizing interference fit locks and minimal non-strip self-tap screws for ease of removal and access to the heat exchanger and combustion air / gas control.

- .12 Acceptable material: "Camus" DYNAFLAME model 6014 hot water boiler c/w all specified options and accessories, or approved equivalent in accordance with B7.

## **2.2 BREECHINGS & STACKS**

- .1 The boiler supplier shall furnish factory designed and pre-fabricated, double wall venting system with supports and terminations tested and Listed by Underwriters Laboratories to UL 1738 / ULC S636, suitable for Category IV appliance through-wall venting.
- .2 The contractor shall field confirm vent routing prior to ordering the vent.
- .3 The venting system components shall be furnished in accordance with the boiler manufacturer's Gas Fired Vent System Design Program.
- .4 The inner flue-gas conduit or single wall stack liner, shall be fabricated from AL 29-C stainless steel. The outer jacket of the system shall be type 316 stainless steel with 25mm (1") of mineral fiber insulation between the flue-gas conduit and the jacket.
- .5 The breeching and stack system joints shall be sealed with a tapered end closure system with tabs, sealant and locking containment bands each band locked from a single point for a pressure tight assembly.
- .6 The breeching and stack system shall maintain air tight integrity at pressures up to 15" w.c. The complete system, installed as per the manufacturer's instructions, may be utilized in either interior or exterior installations and shall be capable of withstanding reasonable wind and incidental loads as required by UL standards.
- .7 The manufacturer of the system must furnish complete CAD system drawings of the assembly to be furnished. A copy of the boiler manufacturer's vent sizing calculation shall be provided with the submittal package.
- .8 Acceptable material: Cheminee Lining Model HEPL1 or approved equivalent in accordance with B7.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Before boiler installation examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations and piping and electrical connections to verify actual locations, sizes and other conditions affecting boiler performance, maintenance and operations.
- .1 Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- .2 Examine mechanical spaces for suitable conditions where boilers will be installed.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 BOILER INSTALLATION**

- .1 Install boilers level on concrete bases or floors. Provide stainless steel levelling shims as required on existing floors. Anchor according to manufacturer recommendations.
- .2 Install gas-fired boilers according to NFPA 54.
- .3 Assemble and install boiler trim.
- .4 Install electrical devices furnished with boiler but not specified to be factory mounted.
- .5 Install control wiring to field-mounted electrical devices.
- .6 Install in accordance with ANSI/ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.

- .7 Make required piping connections to inlets and outlets recommended by boiler manufacturer.
- .8 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .9 Mount unit level.
- .10 Pipe hot water relief valves full size to nearest drain.
- .11 Provide external low water cut-off.
- .12 Comply with all requirements of the Authority Having Jurisdiction (Inspection and Technical Services Manitoba).
- .13 Provide propane piping per CSA B149.1 Natural Gas and Propane Installation Code.

### 3.3 CONNECTIONS

- .1 Piping installation requirements are specified in other Division 23 sections. Drawings indicate general arrangement of piping, fittings and specialties.
- .2 Install piping adjacent to boiler to permit service and maintenance.
- .3 Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- .4 Connect gas piping to boiler gas-train inlet with unions. Piping shall be at least full size of gas train connection. Provide a reducer if required.
- .5 Connect hot-water piping to supply and return boiler tappings with shutoff valve and union or flange at each connection.
- .6 Install piping from safety relief valves to nearest floor drain.
- .7 Boiler Venting
  - .1 Install flue venting kit and combustion-air intake.
  - .2 Connect venting full size to boiler connections.
- .8 Provide condensate neutralizer kits and install per manufacturer's instructions. Pipe to drain using rigid PVC drain lines.
- .9 Ground equipment according to Section 26 05 28 Grounding – Secondary.
- .10 Connect wiring according to Section 26 05 21 Wire and Cable.

### 3.4 FIELD QUALITY CONTROL

- .1 Perform tests and inspections and prepare test reports.
  - .1 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies and equipment installations, including connections, and to assist in testing.
- .2 Tests and Inspections
  - .1 Perform installation and start-up checks according to manufacturer's written instructions.
  - .2 Perform hydrostatic test. Repair leaks and retest until no leaks exist.
  - .3 Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
  - .4 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
    - .1 Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.

- .2 Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- .3 Remove and replace malfunctioning units and retest as specified above.
- .4 Occupancy Adjustments: When requested within 2 months of date of Substantial Completion, provide on-site assistance adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.
- .5 Performance Tests:
  - .1 The boiler manufacturer is expected to provide partial load thermal efficiency curves. These thermal efficiency curves must include at least three separate curves at various BTU input levels. If these curves are not available, it is the responsibility of the boiler manufacturer to complete the following performance tests:
    - .2 Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
    - .3 Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
    - .4 Perform field performance tests to determine capacity and efficiency of boilers.
      - .1 Test for full capacity.
      - .2 Test for boiler efficiency at low fire, 20, 40, 60, 80, 100, 80, 60, 40 and 20 percent of full capacity. Determine efficiency at each test point.
    - .5 Repeat tests until results comply with requirements indicated.
    - .6 Provide analysis equipment required to determine performance.
    - .7 Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
    - .8 Notify Contract Administrator in advance of test dates.
    - .9 Document test results in a report and submit to Contract Administrator.
    - .10 Contractor and manufacturer to provide training in accordance with section 01 79 00 – Demonstration and Training

### **3.5 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 Install all field mounted components, sensors, devices, etc. per manufacturers installation instructions.

### **3.6 MOUNTINGS AND ACCESSORIES**

- .1 Safety valves and relief valves:
  - .1 Run separate discharge from each valve.
  - .2 Terminate discharge pipe as indicated.

### **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**

**Part 1 General**

**1.1 SCOPE OF WORK**

- .1 The scope of work includes all items identified on the drawings and the specifications. The following list of major Work items has been provided as a high-level overview:
  - .1 Install City supplied electrical equipment including 600V circuit breakers, 600:208V 30 kVA transformer, and 208V 100A panel board as per the drawings.
  - .2 Supply and install motor starter MS-BP-5C and all associated power and control wiring. Circulating pump BP-5C E-stop switch shall be supplied and installed by the Electrical Subcontractor.
  - .3 Electrical installation of three boilers including all control devices supplied by the boiler manufacturer. Boiler E-stop switches shall be supplied and installed by the Electrical Subcontractor.
  - .4 Supply and install Carbon Monoxide detector AIT-BXXX and wire to plant DCS.
  - .5 Supply and install all required control wiring between equipment and plant DCS.
  - .6 Perform all required PLC and HMI programming and commissioning for a complete and functioning system.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2.
  - .3 CAN3-C235-83, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .3 City of Winnipeg Standards
  - .1 WSTP Automation Design Guide Rev 03 (612620-0013-40ER-0001)
  - .2 WWD Identification Standard Rev 04
  - .3 WWD Electrical Design Guide Rev 05 (510276-0000-47ER-0001)
  - .4 WSTP Tag Naming Standard Rev 00 (612620-0014-40ER-0001)

**1.3 RELATED SECTIONS**

- .1 This Section covers items common to Sections Division 26, Electrical.

**1.4 ELECTRICAL SUBCONTRACTOR REQUIREMENTS**

- .1 Comply with all Department of Labour, Workplace and Health requirements at all times.
- .2 All contractors shall have a valid license to operate in the City of Winnipeg.
- .3 The complete installation shall be carried out in neat and workmanlike manner to the satisfaction of the Contract Administrator.
- .4 All Electrical Subcontractor employees on Site shall have valid Trade Licenses.

- .5 Electrical Subcontractor shall maintain the appropriate ratio of Journeymen Electricians & Apprentices required by Provincial Codes. Only qualified workmen shall be employed on this contract. Supervision shall be by Journeymen Electricians and Work carried out by Journeymen and/or registered apprentices only.
- .6 Obtain all necessary permits & pay all fees and arrange for inspection with City of Winnipeg.
- .7 Obtain a certificate of final inspection and approval from inspection department having jurisdiction on completion of Work.
- .8 All materials, tools, appliances, scaffolding, apparatus and labour necessary for the execution, erection and completion of specified systems shall be furnished.
- .9 Provide all labour and materials necessary for complete and operating systems as indicated on the drawings and specified herein. Any Work and material, even if not shown or specified, which is obviously necessary or reasonably implied to complete the Work shall be provided as if it was both shown and specified.
- .10 Unless otherwise specifically noted, any issues which are not part of electrical / telecommunication area of expertise, even if mentioned in these documents, are indicated only for reference and coordination purposes only (with other trades).The Electrical Subcontractor shall consult with all other sub-trades involved to confirm the locations of the various outlets and equipment and shall cooperate fully to ensure that no conflict arises during the installation. In case of any difference of opinion, the matter shall be referred to the Contract Administrator for final decision.
- .11 Electrical Subcontractor is responsible for arranging and coordinating with other divisions for proper drainage of electrical conducts entering from outside, drainage of all exterior electrical junction and pull boxes, sealing and waterproofing of all electrical penetrations; methods of firestopping, and envelope penetration.

## **1.5 DEFINITIONS**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

## **1.6 DESIGN REQUIREMENTS**

- .1 All electrical design drawings, details and specifications are diagrammatic, and unless specifically noted by figured dimensions, indicate the general arrangement of receptacles, light fixtures, switches, risers, panels, etc. Any information involving accurate dimensions, shall be obtained from detailed dimensioned drawings or by actual measurements at the building. If doubt exists as to the final location, the Electrical Subcontractor shall contact the Contract Administrator for clarification prior to installation. The location of switches, receptacles, outlets, etc., shall be coordinated with built-in units, appliances and equipment, mechanical equipment, etc., as shown on the architectural and mechanical drawings and/or as existing.
- .2 Where space is indicated for future equipment, leave such space clear and install feeders and equipment pertaining to this contract in such a way that future equipment can be easily installed.
- .3 Electrical Subcontractor shall coordinate locations of lighting fixtures with sprinklers, mechanical ducts, diffusers, beams and other architectural, structural and mechanical items. Any relocation required shall be performed at no cost to the City.
- .4 Operating voltages: to CAN3-C235.

- .5 Language operating requirements: provide identification nameplates and labels for control items in English.

## 1.7 PLANS

- .1 The Electrical Subcontractor shall familiarize them self with the plans which show the approximate locations of outlets and apparatus. The right is reserved to make such changes in location as may be necessary to meet contingencies of construction. No extras will be allowed for such changes to any piece of electrical equipment, outlets, etc.
- .2 Should a discrepancy appear between plans, specifications, or the actual conditions encountered on the Site, which leaves the Electrical Subcontractor in doubt as to the true intention and meaning of the plans and specifications, a ruling shall be obtained in writing from the Contract Administrator which will be final.

## 1.8 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
  - .1 Prior to manufacturing any item required for this job, the Electrical Subcontractor shall submit detailed shop drawings of the item. Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
  - .2 Shop drawings must be received by the Contract Administrator at a date early enough to permit reasonable study prior to review and manufacturer, or to permit alterations where necessary. Facsimile transmission of shop drawings will **NOT BE ACCEPTED**. Late submissions of shop drawings will be sufficient reason for stoppage of construction pending review, or removal and replacement of any unsatisfactory item at the Electrical Subcontractor's expense.
  - .3 Electrical Subcontractor shall allow a minimum of ten (10) business days for shop drawing review by the Contract Administrator and time shall be incorporated in construction schedule so no delays occur due to late submission of shop drawings.
  - .4 Shop drawings shall be submitted by email, bearing Electrical Subcontractors' signatures. All shop drawings shall be stamped by the Electrical Subcontractor prior to submission. Prints will be returned with review stamp and/or appropriate comments.
  - .5 Shop drawings shall be reviewed by the Contract Administrator. Corrections or comments made on the shop drawings during this review do not relieve Electrical Subcontractor from compliance with requirements of the drawings and specifications. This review is only for the general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Electrical Subcontractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her Work with that of all other trades and performing all Work in a safe and satisfactory manner.
  - .6 Shop drawings shall be provided for all system components.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
  - .1 Any electrical material and/or equipment supplied by Contractor or Subcontractors for installation on this project must bear evidence of certification by authorized organization (e.g. CSA) or special certification acceptable to the Chief Inspector of Electrical Energy for the Province of Manitoba.

- .2 Any material and/or equipment not complying with this requirement and found on the job Site will be subject to rejection and replacement with approved equipment at no additional cost.
- .3 Electrical Subcontractor, upon receipt of equipment purchased by the City for installation on this project, shall examine it for compliance with the above requirements. Report any non approved equipment to the Contract Administrator for action. Such equipment shall be returned to its packing crate until instructions are received from the Contract Administrator.
- .4 Submit test results of installed electrical and telecommunication systems.
- .5 Permits and fees: in accordance with General Conditions of contract.
- .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Contract Administrator.
- .4 Substitutions:
  - .1 Unless otherwise noted on the plans or specifications, substitutions may be allowed by the Contract Administrator, when requested by the Electrical Subcontractor or by equipment suppliers, for items specified by manufacturer and catalogue number.
  - .2 Requests for review of such substitutions shall be submitted via email at least seven working days prior to the Bid date. Facsimile transmission of substitution drawings and/or specifications will **NOT BE ACCEPTED**.
  - .3 Descriptive catalogue sheets accompanying the approval application which may show several items of varying specifications shall be conspicuously marked in such a manner that the offered substitute item may easily be recognized for comparison.
  - .4 Proposed substitutions must be at least of equal quality to that of the specified item. The manufacturer's specification of the item shall apply for comparison if no other clause of this specification applies. The Contract Administrator will review substitution proposal and will make final decision for the City.
  - .5 Off-the-shelf items which are specified by description only, without any manufacturer, model type or catalogue number, do not require approval prior to the Bid date. However, Electrical Subcontractor shall submit to the Contract Administrator a request for review of such items prior to their use, in sufficient time to permit rejection if unsatisfactory.
  - .6 All additional expenses incurred as a result of substitution will be the direct responsibility of the Electrical Subcontractor.
- .5 O&M Manuals:
  - .1 Submit O&M manuals in a binder complete with warranty certificate, closed out permit, as-builts, and equipment specification sheets.

## 1.9 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Acts respecting manpower vocational training and qualification.
  - .1 Employees registered in provincial apprentices' program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

## 1.10 DELIVERY, STORAGE AND HANDLING

- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 11 - Cleaning.

**1.11 SYSTEM STARTUP**

- .1 Instruct Operating Personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service technician 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 aspects of its care and operation.

**Part 2 Products**

**2.1 MATERIALS AND EQUIPMENT**

- .1 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from authority having jurisdiction before delivery to Site and submit such approval as described in PART 1 - SUBMITTALS.
- .2 Factory assemble control panels and component assemblies.

**2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

**2.3 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction and Contract Administrator.
- .2 Decal signs, minimum size 175 x 250 mm.

**2.4 WIRING TERMINATIONS**

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminium conductors.

**2.5 EQUIPMENT IDENTIFICATION**

- .1 All equipment shall be identified as per WWD Identification Standard Rev 04 and WSTP Tag Naming Standard Rev 00 (612620-0014-40ER-0001).
- .2 Identify electrical and controls equipment and instrumentation with nameplates and labels as follows:

- .1 Nameplates: lamicoid 3 mm melamine, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
- .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters

NAMEPLATE SIZES			
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	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
Size 8	50 x 100 mm	2 lines	12 mm high letters

- .3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .4 Wording on nameplates and labels to be approved by Contract Administrator prior to manufacture.
- .5 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Identify equipment with Size 3 labels engraved as directed by Contract Administrator. Eg. "P600"
- .8 Terminal cabinets and pull boxes: indicate system and voltage.

## 2.6 WIRING IDENTIFICATION

- .1 All wiring shall be identified as per All equipment shall be identified as per WWD Identification Standard Rev 04 and WSTP Tag Naming Standard Rev 00 (612620-0014-40ER-0001).
- .2 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .3 Maintain phase sequence and colour coding throughout.
- .4 Colour coding: to CSA C22.1.
- .5 Use colour coded wires in communication cables, matched throughout system.
- .6 Identify each wire at termination points with unique wire tag, generally to match existing or as shown on the drawings. Markers shall consist of machine printed sleeves.

## 2.7 CONDUIT AND CABLE IDENTIFICATION

- .1 All conduit and cable shall be identified as per All wiring shall be identified as per All equipment shall be identified as per WWD Identification Standard Rev 04 and WSTP Tag Naming Standard Rev 00 (612620-0014-40ER-0001).
- .2 Colour code conduits, boxes and metallic sheathed cables.
- .3 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.

## 2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

- .1 Paint outdoor electrical equipment "equipment green" finish.
- .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 The Electrical Subcontractor shall obtain and ascertain information from all other sub-trades as to the extent and details of any additional electrical Work to complete all systems served with electrical power or controlled electrically and, where necessary, allow in his Bid for such Work. No extra claim will be accepted for Work on such systems whether they are; as specified in architectural, structural, landscape or mechanical plans and specifications; or proposed and accepted as alternate systems.
- .3 Any electrical and communication Work carried out on behalf of, or by, other Subcontractors shall be in accordance with the regulations of the Canadian Electrical Code and the applicable clauses of this specification.
- .4 It shall be the Electrical Subcontractor's responsibility to ensure that all Subcontractors and suppliers of electrical equipment observe the applicable clauses of the electrical specifications.
- .5 In case of differences between Subcontractors regarding extent of Work responsibilities, such matters shall be referred to the Contract Administrator through the Electrical Subcontractor. Should any discrepancy between the specification and drawings leave the Electrical Subcontractor in doubt as to the true intent and meaning, a ruling shall be obtained from the Contract Administrator before the Bid is submitted. If this is not done it will be the Electrical Subcontractor's responsibility to ensure that the more expensive alternate has been included.
- .6 Prior to the Bid, the Electrical Subcontractor shall visit the Site and report to the Contract Administrator any condition which might prevent him from performing his contract as specified. No extra will be allowed for if this procedure is not followed.
- .7 Should any Work or material be needed which is not specified or shown on the drawings and is nevertheless necessary for properly carrying out the obvious intent, such Work or materials shall be provided without additional cost.

**3.2 NAMEPLATES AND LABELS**

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

**3.3 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: schedule 40 plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

### **3.4 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation. Install electrical equipment at following heights unless indicated otherwise.
  - .1 Wall receptacles:
    - .1 In mechanical rooms: 1400 mm.

### **3.5 CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

### **3.6 FIELD QUALITY CONTROL**

- .1 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Provide upon completion of Work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Power distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .4 Insulation resistance testing:
    - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
    - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
    - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Contract Administrator.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

### **3.7 CLEANING**

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED WORK**

.1	Mechanical Specifications	Division 22 and 23
.2	Common Work Results	Section 26 05 00
.3	Wires and Cables (0-1000 V)	Section 26 05 21
.4	Outlet Boxes, Conduit Boxes and Fittings	Section 26 05 32
.5	Conduits, Conduit Fastenings and Conduit Fittings	Section 26 05 34

**1.2 SYSTEM DESCRIPTION**

- .1 Provide complete electrical power and control connections for mechanical equipment.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Include motor starters, lockable disconnects, conduit, wire, fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment, unless otherwise indicated.
- .2 Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices, and fittings required to provide control wiring for mechanical equipment, except for temperature/humidity control systems.
- .3 Unless otherwise noted, motors and control devices shall be supplied by Division 22 and 23. Motor horsepower ratings shall be as shown in Division 22 and 23 specifications. Motor voltage and phase ratings by Division 26.

**2.2 EXTERIOR EQUIPMENT**

- .1 All equipment, mounted on the exterior of the building, shall be weatherproof.

**Part 3 Execution**

**3.1 POWER WIRING**

- .1 Install power feeders, starters, lockable disconnects, and associated equipment and make connections to all mechanical equipment.
- .2 Install branch circuit wiring for mechanical system control panels, time clocks, and control transformers.
- .3 Install main power feeders to starter/control panels furnished by Division 22 and 23. Install branch wiring from starter/control panels to controlled equipment such as motors, electric coils, etc.
- .4 Conduit, wire, devices and fittings required to wire and connect low voltage temperature control systems, shall be supplied and installed by the trade supplying the temperature control system. Control wiring shall be installed in conduit.
- .5 Wire and connect electrical interlocks for starters supplied by Division 22 and 23.

**3.1 COORDINATION**

- .1 Refer to mechanical drawings for the exact location of motor control devices, and other mechanical equipment requiring an electrical connection.
- .2 Obtain full information from Division 22 and 23, regarding wiring controls, overload heaters, equipment ratings and over-current protection. Notify the Division 22 and 23, at once, if any information provided is incorrect or unsatisfactory.
- .3 Refer to Division 22 and 23 specifications for any further electrical requirements.
- .4 Review both electrical and mechanical drawings and specifications and coordinate all controls with Mechanical Subcontractors through Electrical Subcontractor. Report all discrepancies to the Contract Administrator before close of Bid. No additional money will be justified for assumptions made on any duplication of information.
- .5 Submit to Electrical Subcontractor, as part of the bid submission, a list of controls and wiring to be provided by the Electrical Subcontractor.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1            Materials and installation for wire and box connectors.

**1.2                REFERENCES**

- .1            Canadian Standards Association (CSA International)
  - .1            CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
  - .2            CSA C22.2 No.65-93, Wire Connectors.
- .2            Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1            EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3            National Electrical Manufacturers Association (NEMA)

**Part 2            Products**

**2.1                MATERIALS**

- .1            Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper or copper alloy sized to fit copper conductors as required.
- .2            Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper or copper alloy sized to fit copper conductors 10 AWG or less.
- .3            Clamps or connectors for armoured cable, aluminum sheathed cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.Execution

**2.2                INSTALLATION**

- .1            Remove insulation carefully from ends of conductors and:
  - .1            Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2            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.
  - .3            Install fixture type connectors and tighten. Replace insulating cap.
  - .4            Install bushing stud connectors in accordance with NEMA.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1            Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

**1.2                PRODUCT DATA**

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

**1.3                SCOPE OF WORK**

- .1            Provide a complete system of wiring system, making all required connections as indicated on the drawings, specified herein and as required. Unless noted as larger, install and rate all cables and conductors in accordance with the requirements of the current edition of the Canadian Electrical Code.
- .2            Unless otherwise noted, all systems in the building shall be wired in conduit.

**Part 2            Products**

**2.1                Building Wires**

- .1            Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2            Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

**2.2                1 kV Teck90 Power Cable**

- .1            Cable: to CAN/CSA-C22.2 No. 131.
  - .2            Conductors:
    - .1            Grounding conductor: copper.
    - .2            Circuit conductors: copper, size as indicated. (12 AWG minimum where not indicated)
  - .3            Insulation:
    - .1            Type: ethylene propylene rubber.
    - .2            Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.
  - .4            Inner jacket: polyvinyl chloride material.
  - .5            Armour: interlocking aluminum.
  - .6            Overall covering: thermoplastic polyvinyl chloride material.
- Fastenings:
- .1            One hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.
  - .2            Channel type supports for two or more cables at 300 mm centers.
  - .3            Threaded rods: 6 mm dia. to support suspended channels.

- .7 Connectors:
  - .1 Watertight, explosion-proof approved for TECK cable.

**2.3 600 V Teck90 Control Cable**

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated. (14 AWG minimum where not indicated)
- .3 Insulation:
  - .1 Type: ethylene propylene rubber.
  - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride material.
- .7 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables at 300 mm centers.
  - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors:
  - .1 Watertight, explosion-proof approved for TECK cable

**2.4 300 V Instrument Cable**

- .1 Conductors: 16 AWG, 7 strand concentric lay, Class B tinned copper, twisted pairs/triads.
- .2 Insulation: PVC TW75, 75 °C Wet, 105 °C Dry (-40 °C), 300 Volt.
- .3 Twisted pairs/triads cabled with staggered lays.
- .4 Shielding: Individual twisted pair(s)/triads Aluminum/mylar shield with ST drain wire, 100 % shield. Overall aluminum/mylar shield with ST drain wire. Individual drain wires one size smaller than conductor AWG. Overall drain wire the same AWG as conductors.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride material (90 °C, -40 °C).
- .7 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.

- .2 Channel type supports for two or more cables at 300 mm centers. .
- .8 Connectors:
  - .1 Watertight, explosion proof approved for armoured cable.
- 2.5 Type Rw90 Conductor**
  - .1 In accordance with CSA C22.2 No.38
  - .2 Circuit conductors shall be concentric stranded soft copper, size as indicated (12 AWG minimum where not indicated).
  - .3 Insulation to be chemically cross-linked thermosetting polyethylene rated type RW90 XLPE, 600V
  - .4 Suitable for installation in temperatures down to -40 °C.
  - .5 90 °C conductor operating temperature.
- Part 3 Execution**
  - 3.1 Installation Of Building Wires**
    - .1 Install wiring as follows:
      - .2 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit and Conduit Fittings.
  - 3.2 Installation Of Teck Cable 0 -1000 V**
    - .1 Install cables.
      - .1 Group cables wherever possible on channels.
      - .2 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors - 0 -1000 V.
  - 3.3 Installation Of Armoured Cables**
    - .1 Group cables wherever possible.
    - .2 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors - 0 -1000 V.
  - 3.4 Installation Of Control Cables**
    - .1 Install control cables in conduit.
    - .2 Ground control cable shield.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 - Common Work Results - Electrical.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
  - .1 ANSI/IEEE 837-1989, Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association, (CSA International)

**1.3 SCOPE OF WORK**

- .1 Provide all labour and material to constitute a complete system, equipment grounding and bonding.
- .2 Ground all components of the electrical system in accordance with the requirements of the Canadian Electrical Code, local authorities and, where more stringent, manufacturers requirements.
- .3 Securely and adequately ground all components of the electrical system in accordance with the requirements of the CEC and additional requirements set up in the contract documents.
- .4 The system shall consist of, but not be limited to cables and supports and all necessary materials to provide a complete system.

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Insulated grounding conductors: green, type RW90.
- .2 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.

**Part 3 Execution**

**3.1 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including conductors, connectors, and accessories. Where EMT is used, run ground wire in conduit.
- .2 All locknuts, connectors and couplings shall be tight fitting and properly cinched, throughout the entire electrical distribution system for grounding and bonding purposes as required by the CEC.

- .3 Ground Connections:
  - .1 When making ground and bonding connections, apply a corrosion inhibitor to contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between metals used.
- .4 All joints between conductors of #6 AWG and larger shall be made with "Cadweld" process. Special permission from Contract Administrator is required where bolted pressure lugs or screw type "Hydent" connectors are installed.
- .5 All bolted ground connections must be accessible.
- .6 Install rigid PVC conduit sleeves where ground wires pass through concrete slabs.
- .7 Connect grounding conductors to motors 10 hp and above or circuits 20A or above, with a solderless terminal and a bolt tapped to motor frame or equipment housing. Connect to smaller motors or equipment by fastening terminal to a connection box. Connect junction boxes to equipment grounding system with grounding clips mounted directly on box or with machine screws. Completely remove paint, dirt, or other surface coverings at grounding conductor connection points so good metal-to-metal contact is made.
- .8 Install bonding wire in all flexible conduit connected at each end to a grounding bushing by a solderless lug, clamp, cup washer and screw. Soldered joints not permitted.
- .9 Install #4 AWG bond wire along the full length of cable trays and between separate sections of trays and bond cable tray as required.
- .10 Ground conductors not sized on drawings are to be sized in accordance with local governing electrical authority requirements. Ground conductor size is to be no smaller than requirements specified herein this article or on drawings.
- .11 Install connectors in accordance with manufacturer's instructions.
- .12 Protect exposed grounding conductors from mechanical injury.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 Common Work Results Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to Site conditions and to approval of the local inspection authority. A report shall be submitted to the Contract Administrator from the testing agency.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator, if provided, during tests.

**END OF SECTION**

**Part 1            General**

**1.1**            Not Used

**Part 2            Products**

**2.1            SUPPORT CHANNELS**

- .1            U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended, set in poured concrete walls and ceilings.
- .2            All hardware, supports and channels shall be hot dipped galvanized.

**Part 3            Execution**

**3.1            INSTALLATION**

- .1            Secure equipment to masonry, tile and plaster surfaces with lead shields. Use Aluminum shields or as approved by anchoring manufactures recommendations for specific surfaces.
- .2            Secure equipment to poured concrete with expandable inserts.
- .3            Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4            Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5            Fasten exposed conduit or cables to building construction or support system using straps.
  - .1            One-hole steel straps to secure surface conduits and cables 50 mm and smaller where above 2700mm.
  - .2            Two-hole steel straps to secure surface conduits and cables 50 mm and smaller where below 2700mm.
  - .3            Two-hole steel straps for conduits and cables larger than 50 mm.
  - .4            Beam clamps to secure conduit to exposed steel Work.
- .6            Suspended support systems.
  - .1            Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2            Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7            For surface mounting of two or more conduits use channels at 2 m on centre spacing.
- .8            Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9            Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10            Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11            Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.

- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1        CSA C22.1, Canadian Electrical Code (CEC), Part 1.

**Part 2            Products**

**2.1                OUTLET AND CONDUIT BOXES GENERAL**

- .1        Size boxes in accordance with CSA C22.1.
- .2        102 mm square or larger outlet boxes as required for special devices.
- .3        Gang boxes where wiring devices are grouped.
- .4        Blank cover plates for boxes without wiring devices.
- .5        Combination boxes with barriers where outlets for more than one system are grouped.
- .6        All electrical boxes and fittings shall be corrosion resistant and watertight in pool areas, otherwise sprinkler proof.

**2.2                SHEET STEEL OUTLET BOXES**

- .1        Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2        102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .3        102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished tile walls.

**2.3                CONDUIT BOXES**

- .1        Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle. This is only allowed in mechanical spaces.

**2.4                OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE**

- .1        Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

**2.5                FITTINGS - GENERAL**

- .1        Bushing and connectors with nylon insulated throats.
- .2        Knock-out fillers to prevent entry of debris.
- .3        Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4        Double locknuts and insulated bushings on sheet metal boxes.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of Work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

**END OF SECTION**

**Part 1 General**

**1.1 SCOPE OF WORK**

- .1 Provide conduit system as indicated herein, on the drawings and as required.
- .2 All home run wiring in the building shall be installed in conduit unless otherwise noted.

**Part 2 Products**

**2.1 CONDUITS**

- .1 Rigid Steel Conduit
  - .1 Galvanized with threaded joints and connections.
  - .2 Connections in dry locations: steel or malleable iron lock nuts inside and outside enclosures.
  - .3 Connectors subject to moisture: Liquid and dust tight with insulated throat.
  - .4 Fittings: steel
  - .5 Do not use process piping in lieu of CSA approved conduit.
- .2 EMT Conduit
  - .1 Hot dipped galvanized steel conduit.
  - .2 Fittings: steel or malleable iron, liquid tight, compression-type, with insulated throat or non-metallic bushings, this is typical for all exterior connections.
- .3 Flexible Conduit
  - .1 Conduit: spiral wound, interlocking flexible.
  - .2 Connectors: slip-proof insulated throat or non-metallic bushings, steel type.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Flexible Conduit shall be used for line and low voltage circuit connections to all motors or equipment subject to vibration and shall be metal PVC coated watertight. Connectors shall be approved for flexible liquid tight conduits.
- .2 Unless otherwise noted, Electrical Metallic Tubing (EMT) shall be utilized in the building.
- .3 Install all conduit and wiring concealed, except where specifically noted otherwise. Do not recess conduit in columns or concrete slabs.
- .4 Where conduit is run exposed, run parallel to building lines. Where conduits are grouped (two or more), space evenly, make bends concentric and mount on racks.
- .5 Lay out conduit to avoid interference with other Work. Maintain a minimum clearance of 150mm from steam or hot water piping, etc.

- .6 All wiring shall be installed in EMT raceways with water tight connectors except where installed outdoors. All raceways installed outdoors shall be hot dipped rigid galvanized steel with treaded fittings.
- .7 Where used, sleeves shall be c/w proper connectors and plastic bushing (this is particularly important for telecommunications cabling installation.)
- .8 Watertight fittings shall be installed in areas exposed to moisture and concrete type fittings in concrete slabs.
- .9 Where conduit is required to be bent, do not heat and do not bend in such a way as to reduce the cross-sectional area at any point.
- .10 For all runs of conduit, do not include more than the equivalent of four 90-degree bends, including bends located immediately adjacent to an outlet box or fitting. Provide pulling elbows, pull boxes and/or junction boxes where necessary.
- .11 Where possible, install conduits so that they are not trapped. Cap turned up conduits to prevent the entrance of any dirt or moisture during construction. If necessary, swab out conduit and thoroughly clean internally before wires and cables are pulled.
- .12 Take extreme care in reaming ends of all conduit to ensure a smooth, interior finish that will not damage the insulation of the wires.
- .13 Use insulated non-metallic bushings on all conduit terminators. Ensure electrical continuity in all conduit systems. All conduits shown exposed in finished areas are to be free of labels and trade marks. Install a 45kg test line in all empty conduits. Conduits and ducts crossing building expansion joints shall have conduit expansion fittings to suit the type of conduit used. Seal conduits with duct seal where conduits are run between heated and unheated areas or into freezers. Where conduits, cables, or cable trays pierce fire separations, seal openings with approved sealing compound.

### **3.2 SLEEVES AND CHASES**

- .1 Sleeves shall be provided and set for conduit passing through foundations, concrete walls and floors. Sleeves shall have sufficient diameter to allow free conduit movement resulting from thermal expansion and contraction. Sleeves installed through foundation walls, beams and footings shall be installed flush with walls, partitions, floors and ceilings. All sleeves installed below grade shall be caulked with oakum and lead on both sides of the wall. Sleeves in floors where water is present shall be caulked, graphite packing, and waterproof sealant used.
- .2 Exact locations of conduit stub ups for connection to service equipment, signs etc., shall be checked and verified with the Contract Administrator. Shop drawings shall be issued prior to rough-in and slab being poured.
- .3 No extra claim will be accepted by the Contract Administrator for stub up adjustments as a result of the Electrical Subcontractor not following the checking procedure as described under item 2.
- .4 Adjustments of stub ups shall be carried out to the satisfaction of the Contract Administrator. Damaged surfaces shall be repaired to their original condition. Conduit extension shall comply with Canadian Electrical Code and wires are to be re-pulled.

**3.3 EMPTY CONDUITS**

- .1 All empty conduits shall be c/w pull wires.
- .2 All conduits stubbed out shall be provided with rubber grommets and end caps.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 CSA International
  - .1 CAN/CSA-C22.2 No.47-13 (R2018), Air-Cooled Transformers (Dry Type).
  - .2 CSA C9-17, Dry-Type Transformers.
  - .3 CAN/CSA-C802.2-18, Minimum Efficiency Values for Dry Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)
- .3 Canada's Energy Efficiency Act and Energy Efficiency Regulations

**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 dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.

**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 dry type transformers for incorporation into manual.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 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 and protect dry type transformers from nicks, scratches, and blemishes.
  - .2 Replace defective or damaged materials with new.

**Part 2 Products**

**2.1 DESIGN DESCRIPTION**

- .1 **Transformer**
  - .1 General: Transformer XFMR-1B1 supplied by the City and installed by the Electrical Subcontractor.
  - .2 Type: ANN.
  - .3 3 phase, 30kVA
  - .4 Voltage taps: Minimum two taps above and two taps below at 2.5% increments, full capacity.
  - .5 Insulation: 150°C Rise
  - .6 Basic Impulse Level (BIL): standard.

- .7 Hipot: standard.
- .8 Average sound level: standard.
- .9 Impedance at 17 degrees C: standard.
- .10 Enclosure: NEMA 3R.
- .11 Mounting: Wall
- .12 Finish: in accordance with Section 26 05 00- Common Work Results for Electrical.
- .13 Aluminum windings.
- .14 Lifting hooks for lifting complete transformer assembly.

## **2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Label size: 7.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for transformers 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 INSTALLATION**

- .1 Mount dry type transformers up to 35 kVA as indicated on drawings.
- .2 Mount dry type transformers above 35 kVA on floor.
- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.
- .9 Make conduit entry into bottom 1/3 of transformer enclosure.

### **3.3 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

**3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by dry type transformers installation.

**END OF SECTION**

## Part 1 General

### 1.1 SECTION INCLUDES

- .1 Materials and installation for standard and custom breaker type panelboards.

### 1.2 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.
- .2 Section 26 28 21 - Moulded Case Circuit Breakers.

### 1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.29-M1989 (R2000), Panelboards and Enclosed Panelboards.
- .2 City of Winnipeg
  - .1 Identification Standard – 510276-0000-40ER-0002.
  - .2 Tag Naming Standard – 612620-0014-40ER-0001.

### 1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00 – General Provisions of this Bid Opportunity.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

## Part 2 Products

### 2.1 PANELBOARDS

- .1 General: Panelboard PNL 1B1 supplied by the City and installed by the Electrical Subcontractor.
- .2 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
  - .1 Install circuit breakers in panelboards before shipment.
  - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .3 250 V panelboards: Bus and breakers rated as indicated on drawings. 10 kA (symmetrical) interrupting capacity minimum.
- .4 600 V panelboards: Bus and breakers rated as indicated on drawings. 22 kA (symmetrical) interrupting capacity minimum.
- .5 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .6 Panelboards: tin plated copper mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .7 Enclosure type: as indicated on drawings.
- .8 Two keys for each panelboard and key panelboards alike.

- .9 Tin plated copper bus with neutral of same ampere rating as mains.
- .10 Mains: suitable for bolt-on breakers.
- .11 Trim with concealed front bolts and hinges.
- .12 Trim and door finish: baked grey enamel.

## **2.2 BREAKERS**

- .1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to City of Winnipeg.

## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Nameplate for each panelboard Size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards Size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 01 - Common Work Results - Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Provide lesser of 20% spare 15A breakers or 5 spare breakers.

**END OF SECTION**

**Part 1            General**

**1.1                ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Submit product data sheets for compartments. Include product characteristics, physical size and finish.
- .3    Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, and cleaning procedures.
- .4    Submit shop drawings and indicate:
  - .1    Outline dimensions.
  - .2    Configuration of identified compartments.
  - .3    Schematic and wiring diagrams.
- .5    Closeout Submittals: provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .1    Include data for each type and style of starter.

**1.2                EXTRA MATERIALS**

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

**Part 2            Products**

**2.1                GENERAL DESCRIPTION**

- .1    Existing Cutler-Hammer Freedom Series 2100 MCC, Floor mounting, free standing, enclosed dead front.

**2.2                FEEDER TAP UNIT**

- .1    General: Feeder tap unit to be installed in MCC-1B shall be supplied by the City and installed by the Electrical Subcontractor.
- .2    Provide feeder tap complete with circuit breakers as indicated on the drawing to suit the existing MCC.
- .3    External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for padlocks to lock operating handle in "off" position and lock door closed.
- .4    Hinge unit doors on same side.

**2.3                WIRING IDENTIFICATION**

- .1    Match existing.

**2.4                EQUIPMENT IDENTIFICATION**

- .1    Match existing.

**2.5 FINISHES**

- .1 Match existing.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install feeder tap unit in the existing MCC as indicated on the electrical drawings.
- .2 Make field power connections as required.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Ensure moving and working parts are lubricated where required.
- .3 Operate starters in sequence to prove satisfactory performance of motor control centre during 8 hours period.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Switches, receptacles, wiring devices, cover plates and their installation.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results - Electrical.

**1.3 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 CSA-C22.2 No.55-M1986, Special Use Switches.
  - .4 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20).

**1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

**Part 2 Products**

**2.1 RECEPTACLES**

- .1 Duplex receptacles, CSA type 5-15 R 5-20R and 6-50R, 125/250V V, 15/20/50 A, U ground, to: CSA-C22.2 No.42 with following features:
  - .1 White urea moulded housing for normal switches. Co-ordinate with Contract Administrator for all unique coloured receptacles.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and riveted grounding contacts.
  - .6 Nylon face
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.
- .4 Acceptable materials: Industrial Grade.

**2.2 Switches**

- .1 15 A, 120 V, single pole, double pole, three-way, four-way industrial grade switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111 as required.

- .2 Manually-operated general purpose AC switches with following features:
  - .1 Terminal holes approved for No. 10 AWG wire.
  - .2 Silver cadmium oxide contacts.
  - .3 Fully enclosed with urea or melamine moulding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 Red toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project.
- .5 Acceptable materials: Hubbell 1200 Series or equivalent.

### **2.3 COVER PLATES**

- .1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .5 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Cover plates:
  - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other Work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1            Materials for moulded-case circuit breakers, and ground-fault circuit-interrupters.

**1.2                RELATED SECTIONS**

- .1            Section 01 33 00 - Submittal Procedures.

**1.3                REFERENCES**

- .1            Canadian Standards Association (CSA International).
  - .1            CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489 and the NMX-J-266-ANCE).

**1.4                SUBMITTALS**

- .1            Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2            Include time-current characteristic curves for breakers with ampacity of 100 A and over or with interrupting capacity of 25 kA symmetrical (rms) and over at system voltage.

**Part 2            Products**

**2.1                BREAKERS GENERAL**

- .1            Moulded-case circuit breakers and ground-fault circuit-interrupters: to CSA C22.2 No. 5
- .2            Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.
- .3            Common-trip breakers: with single handle for multi-pole applications.
- .4            Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1            Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5            Circuit breakers with interchangeable trips as indicated.

**2.2                THERMAL MAGNETIC BREAKERS**

- .1            Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

**2.3                OPTIONAL FEATURES**

- .1            Include:
  - .1            On-off locking device.
  - .2            Handle mechanism.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Install circuit breakers as indicated on drawings.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1            Materials and installation for industrial control devices including pushbutton stations, control and relay panels.

**1.2                RELATED SECTIONS**

- .1            Section 01 33 00 - Submittal Procedures.
- .2            Section 26 05 00 - Common Work Results - Electrical.

**1.3                REFERENCES**

- .1            Canadian Standards Association (CSA International)
  - .1            CSA C22.2 No.14-95, Industrial Control Equipment.
- .2            National Electrical Manufacturers Association (NEMA)
  - .1            NEMA ICS 1, Industrial Control and Systems: General Requirements.

**1.4                SHOP DRAWINGS**

- .1            Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2            Include schematic, wiring, interconnection diagrams.

**1.5                QUALITY ASSURANCE**

- .1            Submit to Contract Administrator one copy of test results.

**Part 2            Products**

**2.1                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 solid state. Contact rating: as required.

**2.2                RELAY ACCESSORIES**

- .1            Standard contact cartridges: normally-open - convertible to normally-closed in field.

**2.3                OPERATOR CONTROL STATIONS**

- .1            Enclosure: CSA Type 4X, flush mounting:

**2.4                PUSHBUTTONS**

- .1            Illuminated, heavy duty oil tight, flush operator with 1-NO and 1-NC contacts rated at as required.

**2.5                EMERGENCY STOP PUSHBUTTONS**

- .1            Illuminated, heavy duty oil tight, flush operator with 1-NO and 1-NC contacts rated at as required, operator and contact block included.

- .2 Jumbo Red Operator.
- .3 Push to operate, key only to reset.
- .4 Lamicoid, large white letters on red background; stating "Equipment Emergency Stop".

**2.6 SELECTOR SWITCHES**

- .1 Maintained 3 position labelled as indicated heavy duty oil tight, operator's standard, contact arrangement.

**2.7 INDICATING LIGHTS**

- .1 Heavy duty Oil tight, full voltage, LED type.

**2.8 CONTROL AND RELAY PANELS**

- .1 CSA Type sprinklerproof sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

**2.9 CONTROL CIRCUIT TRANSFORMERS**

- .1 Single phase, dry type.
- .2 Primary: 208 V, 60 Hz ac.
- .3 Secondary: 24 or 120 VAC as required.
- .4 Rating: 100 VA minimum.
- .5 Secondary fuse: rated as required.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install as required.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform tests 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 time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED WORK**

- .1            Refer to all sections of the specification for related Work.

**1.2                SHOP DRAWINGS AND PRODUCT DATA**

- .1            Submit shop drawings and product data in accordance with Section 26 05 00 Common Work Results - Electrical.
- .2            Indicate:
  - .1            Mounting method and dimensions.
  - .2            Starter size and type.
  - .3            Layout of identified internal and front panel components.
  - .4            Enclosure types.
  - .5            Wiring diagram for each type of starter.
  - .6            Interconnection diagrams.

**1.3                OPERATION AND MAINTENANCE DATA**

- .1            Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 26 05 00 Common Work Results - Electrical.
- .2            Include operation and maintenance data for each type and style of starter.

**1.4                MAINTENANCE MATERIALS**

- .1            Provide maintenance materials in accordance with Section 26 05 00 Common Work Results - Electrical.

**Part 2            Products**

**2.1                MATERIALS**

- .1            Starters: EEMAC (Electrical and Electronic Mfg. Association of Canada) standard "E14-1".
  - .1            Half size starters not acceptable.

**2.2                FULL VOLTAGE MAGNETIC STARTERS**

- .1            Magnetic and combination magnetic with components as follows:
  - .1            Contactor solenoid operated, rapid action type.
  - .2            Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3            Motor circuit interrupter with operating lever on outside of enclosure and provision for:
    - .1            Locking in "OFF" position with up to 3 padlocks.
    - .2            Locking in "ON" position.

- .3 Provision for preventing switching to "ON" position while enclosure door open.
- .4 Power and control terminals.
- .5 Wiring and schematic diagram inside starter enclosure in visible location.
- .6 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include motor circuit protector as follows:
  - .1 Breakers to be specifically designed for motor applications, with adjustable trips fixed with a locking pin.
  - .2 Interrupting rating to suit available RMS sym.
  - .3 Size trip as a function of motor nameplate FLA, and in accordance with manufacturer's recommendations.
  - .4 Locking in "OFF" position with up to 3 padlocks.
  - .5 Locking in "ON" position.
  - .6 Independent locking of enclosure door.
  - .7 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
  - .1 Oil tight selector switches: HOA labelled.
  - .2 Oil tight indicating lights: red running push to test lamps.
  - .3 1-N/O and 1-N/C spare auxiliary contacts.

## **2.3 CONTROL TRANSFORMER**

- .1 Single phase, dry type, control transformer with 120-volt secondary voltage unless indicated otherwise, complete with primary and secondary fuse installed in starter.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

## **2.4 FINISHES**

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 Common Work Results - Electrical.
- .2 Enclosures to be NEMA 12.

## **2.5 EQUIPMENT IDENTIFICATION**

- .1 Manual starter designation label, black plate, white letters, size 1, engraved lamacoid.
- .2 Magnetic starter designation label, black plate, white letters, size 3, engraved lamacoid.

## **2.6 RELAYS**

- .1 Install protective relays where motors are provided with thermistors.

## **2.7 MANUFACTURERS**

- .1 Acceptable manufacturer: GE, Allen Bradley, Eaton (Cutler Hammer) or Schneider (Square D).

- .2 Recommended Vendor: Integrated Power Services (IPS) or approved equal.

**Part 3 Execution**

**3.1 STARTER VERIFICATION**

- .1 Field check motor starters supplied prior to commissioning equipment. As a minimum, verify the following:
  - .1 Check of control circuits.
  - .2 Verify that overload relay installed is correctly sized for motor used.
  - .3 Current test overload relay, to ensure that relay trips at its prescribed rating (use a low-voltage high current test set), or equivalent.
  - .4 Visual inspection of breakers and contactors.
- .2 Measure motor amps under load conditions and compare with full load amps and motor service factor. Report any excessive imbalance. Measure voltage and motor terminals. Voltage to be approximately 575 to 590 volts.
- .3 Record settings of MCP and relays, etc. and include in Operation and Maintenance manual.

**3.2 OVERLOAD RELAYS**

- .1 For starters provided, select overload relays in accordance with relay and motor manufacturers' recommendations, considering motor service factors, ambient temperature, temperature differences between motor and starter locations. Monitor motor operation during start-up to ensure motor operation is satisfactory and relays provide proper protection. For side inlet and other long acceleration time motors, provide special overload relays to suit the start-up condition. Provide manufacturers' curves and data sheets where necessary to provide supporting data for motor protection and to perform a co-ordination study.
- .2 Adjust relay settings for motors provided with thermistors

**END OF SECTION**

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**Part 1 GENERAL**

**1.1 SCOPE OF WORK BY CONTRACTOR**

- .1 The scope of work includes all items identified on the drawings and the specifications. The work shall be performed as per WSTP Automation Design Guide Rev 03. The following list of major Work items has been provided as a high-level overview:
  - .1 Perform all required start-up, testing and commissioning of the new boilers B-5A, B-5B and B-5C, including local HMI, as outlined in Section 23 52 00 Heating Boilers, and Appendix B Commissioning Plan.
  - .2 Provide operator training for the new boilers B-5A, B-5B and B-5C as outlined in Section 23 52 00 Heating Boilers.
  - .3 Supply and installation of carbon monoxide detector and boiler header temperature sensor.
  - .4 Installation of instrumentation and control devices supplied loose with boilers B-5A, B-5B and B-5C.
  - .5 Perform required loop checks as indicated in Appendix B Commissioning Plan.
  - .6 Perform motor bump tests as indicated in Appendix B Commissioning Plan.
  - .7 Provide support during Plant DCS commissioning and testing by the City.

**1.2 SCOPE OF WORK BY THE CITY**

- .1 This section outlines the scope of work that will be completed by the City.
  - .1 Plant DCS PLC programming for modification to existing equipment and addition of new equipment.
  - .2 Plant DCS HMI (S+ SCADA) programming for modification to existing equipment and addition of new equipment.
  - .3 Provide operator training for the new modifications to the plant DCS.

**1.3 RELATED SECTIONS**

- .1 Section 26 05 00 – Common Work Results – Electrical for general component Identification and support requirements.

**1.4 REFERENCES**

- .1 City of Winnipeg Standards
  - .1 WSTP Automation Design Guide Rev 03 (612620-0013-40ER-0001)
  - .2 WWD Identification Standard Rev 04
  - .3 WSTP Tag Naming Standard Rev 00 (612620-0014-40ER-0001)
  - .4 Appendix B Commissioning Plan

**1.5 DEFINITIONS**

- .1 PLC: Programmable Logic Controller
  - .2 DCS: Distributed Control System
  - .3 LCD: Liquid Crystal Display
  - .4 LED: Light Emitting Diode
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- .5 COM: Communications
- .6 LAN: Local Area Network
- .7 PVC: Poly Vinyl Chloride
- .8 CMF: Central Monitoring Facility

## 1.6 SUBMITTALS

- .1 General: Submit items in this Article according to Section 26 05 00 – Common Work Results – Electrical.
- .2 Product Data for monitoring and control equipment shall include physical dimensions and data on features, components, ratings, and performance. Include wiring diagram and elevation views of the front display panel/keypad where applicable.
- .3 Shop Drawings detailing dimensions, components, location and identification of field connections, arrangement of components and operational characteristics.
- .4 Wiring Diagrams detailing the installation of the equipment and differentiating between factory-installed and field-installed wiring.

## 1.7 CLOSEOUT SUBMITTALS

- .1 Final Report:
  - .1 Include measurements, final settings and certified test results.
  - .2 Include completed commissioning forms.
  - .3 Bear signature of commissioning technician and supervisor.
  - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications as set during commissioning and submit to the Contract Administrator in accordance with Contract Document.
  - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

## 1.8 QUALITY ASSURANCE

- .1 Electrical Component Standard: Provide components that are listed and labelled by CSA or cUL where applicable.
- .2 Listing and Labelling: Provide products specified in this Section that are listed and labelled by an organization that has been accredited by the Standards Council of Canada.

## 1.9 COMMISSIONING FORMS

- .1 The commissioning forms are included in Appendix B Commissioning Plan.
  - .2 Supplement the commissioning forms as required to make a complete commissioning report package.
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**1.10 COMMISSIONING**

- .1 Carry out commissioning under direction of the Contract Administrator and in the presence of representatives of the Contract Administrator and the City.
- .2 Inform, and obtain approval from the Contract Administrator in writing at least 14 days prior to commissioning or each test. Indicate:
  - .1 Location and part of system to be tested or commissioned.
  - .2 Testing/commissioning procedures, anticipated results.
  - .3 Names of testing/commissioning personnel.
  - .4 Correct deficiencies and re-test until satisfactory performance is obtained.
  - .5 Acceptance of tests will not relieve Electrical Subcontractor from responsibility for ensuring that complete systems meet every requirement of Contract.
  - .6 Perform tests as required.

**1.11 COMPLETION OF COMMISSIONING**

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by the Contract Administrator.

**1.12 TRAINING FOR EACH SITE**

- .1 Training shall be provided as per Section 23 52 00 Heating Boilers.

**1.13 WARRANTY**

- .1 Warranty Period: One (1) year from the date of Substantial Completion and Acceptance unless otherwise indicated in other sections of this specification.

**Part 2 PRODUCTS**

**2.1 LOW WATER CUTOFF SWITCH**

- .1 General: Supplied by Boiler Manufacturer, wired by Electrical Subcontractor.
- .2 Power supply: 120 VAC.
- .3 Low water cutoff switch will be McDonnell & Miller, Model: RB-122-E.

**2.2 FLOW SWITCH**

- .1 General: Supplied by Boiler Manufacturer, wired by Electrical Subcontractor.
- .2 Power supply: 120 VAC.
- .3 Flow switch will be McDonnell & Miller, Model: FS4-3.

**2.3 GAS DETECTION TRANSMITTER**

- .1 General: Supplied and installed by Electrical Subcontractor.
  - .2 Gas Element type: Ultima XIR 3 Wire carbon Monoxide (CO) c/w junction box
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- .3 Controller: GasGard XL Controller Model No. A-GASGARDXL-4-2-1-0
- .4 Type: Integral LCD Display
- .5 Enclosure Class: NEMA 4X
- .6 Power Supply: 24VDC
- .7 Approvals: CSA
- .8 Measuring Rang: 0 to 1000 PPM
- .9 Allowable Operating Temperature: -40 to + 60°C
- .10 Approved Manufacturer: MSA, UltimaX gas detection system and GasGard XL Controllers (Standardized by the City via RFP 449-2014, no alternates or substitutes will be accepted).
- .11 Approved Vendor: Tundra Process Solutions (Standardized by the City via RFP 449-2014, no alternates or substitutes will be accepted).

#### **2.4 PROCESS TEMPERATURE ELEMENTS AND TRANSMITTER**

- .1 RTD actuated temperature transmitters c/w thermowell.
  - .2 Application: Used for ranges of -40°C to 100°C.
  - .3 External Load Capacity: 500  $\Omega$  minimum for 24 VDC supply.
  - .4 Element Burnout: On element burnout or open circuit the transmitter output will be driven upscale or downscale as determined by system safety.
  - .5 Performance:
    - .1 Accuracy:  $\pm 0.02\%$  of span.
    - .2 Stability: Greater of  $\pm 0.25\%$  of reading for 5 years.
    - .3 Deadband: 0.5% of span.
    - .4 Hysteresis: 0.2% of span.
    - .5 Ambient Temperature Effect: 0.0008°F per 1°F.
    - .6 Electrical Connection: 0.5 inch NPT.
    - .7 All temperature transmitters shall be accompanied by calibration certificates from vendor and shall be c/w HART protocol.
  - .6 RTDs shall adhere to the following specifications:
    - .1 Sensor Element: Pt100.
    - .2 Temperature Coefficient: 0.00385 ohms/ohm/c.
    - .3 Measuring Range: 60°C to +121°C (depending upon element)
    - .4 Wiring Configuration: 3-wire.
  - .7 All temperature elements shall be installed using nipple-union-nipple assemblies.
  - .8 Approved Manufacturer: SITRANS TF (Standardized by the City via RFP 449-2014, no alternates or substitutes will be accepted).
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- .9 Approved Vendor: Trans-West Supply (Standardized by the City via RFP 449-2014, no alternates or substitutes will be accepted).

**Part 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install equipment according to manufacturer's written installation instructions.
- .2 Mount control equipment according to manufacturer's instructions and Section 26 05 00 – Common Works Results – Electrical.
- .3 Install wiring between control devices as specified in Section 26 05 21 – Wires and Cables.
- .4 Bundle, train, and support wiring in enclosures.
- .5 Identify components along with power and control wiring according to Section 26 05 00 – Common Works Results – Electrical.

**Part 4 PROCESS CONTROL NARRATIVE**

**4.1 GENERAL**

- .1 Process control narrative for new and existing equipment is outlined in the following sections. Refer to Appendix B Commissioning plan for I/O List and additional details.

**4.2 BOILER CIRCULATION PUMPS**

- .1 Existing boiler circulating pumps B551-1BP35 and B552-1BP36 will be dedicated to boiler B-5A and B-5B respectively. Existing circulating pump control shall be modified to suit new boiler control. New boiler circulating pump BP-5C will be dedicated to new boiler B-5C.
- .2 Existing boiler circulation pumps (B551-1BP35 and B552-1BP36) are controlled by VFD. Existing circulation pumps are turned on manually by the operators using a local hand switch. Pump speed is controlled manually by the operators using existing VFD local controls. Significant updates to existing boiler circulation pump B551-1BP35 and B552-1BP36 control are not anticipated. Pump run status will be sent to the plant DCS.
- .3 New boiler circulation pump BP-5C operates at constant speed. New circulation pump shall be turned on manually by the operators using a local hand switch. A pump run status will be sent to the plant DCS.
- .4 HMI graphics are to be updated to include the boiler circulation pump BP-5C and any required modifications to the existing B551-1BP35 and B552-1BP36.

**4.3 BOILER LOW-FLOW PUMP BP-5D CONTROL**

- .1 Low-flow pump BP-5D will be operated manually by a local hand switch. The pump shall be permitted to run only when 0, 1, or 2 of the three boiler pumps (B551-1BP35, B552-1BP36 or BP-5C) are running. Low-flow pump BP-5D shall be interlocked using an enable signal from the plant DCS to prevent the pump from running when all three (3)

boiler pumps are running. A pump run status feedback signal shall be input to the plant DCS.

#### **4.4 BOILER B-5A, B-5B, AND B-5C CONTROL**

- .1 The new boilers will only be operated in the event of a failure to the existing boilers (1-4). However, each boiler should be operated during a regular scheduled interval to maintain good working condition.
- .2 All three boilers (B-5A, B-5B, and B-5C) are standby units to existing boilers (1-4). Operators will stage on the new boilers individually depending on the amount of supplemental heating required.
- .3 The operator shall be able to enable the boiler from the plant DCS. The Boiler Enable signal shall be on when:
  - .1 The operator sets the boiler to enable, and
  - .2 the pump run status for the circulation pump associated with the boiler has been received.
- .4 Once the boiler receives the Boiler Enable signal from the plant DCS the operator shall be able to manually turn the boiler on using the "Burner Enable" switch on the local HMI. Each boiler will run to maintain an internal water outlet setpoint of 107 °C.
- .5 Each boiler will have flow and low water level cutoff switches wired directly to the internal boiler controller.
- .6 A Boiler Fault alarm will be input to the plant DCS based on a common alarm generated from the boiler internal controller. The operator will be required to investigate the boiler alarm locally. Once the alarm condition is no longer active in the field the operator shall be able to acknowledge the alarm on the plant DCS.
- .7 HMI graphics will be updated by the City to include the new boilers B-5A, B-5B and B-5C and associated pumps.

#### **4.5 GAS DETECTION (CO)**

- .1 AIT-B503 CO alarm shall be wired from the controller to the plant DCS. An alarm shall be generated when the CO level is above 30 PPM.
- .2 AIT-B503 CO controller fault status shall be wired from the controller to the plant DCS.
- .3 The controller local audible alarm shall be output when the CO level is above 30 PPM.
- .4 The CO alarm can be reset or acknowledged using local hand switch HS-AIT-B503.
- .5 Perform all calibration, testing and commissioning as per manufacturer's instructions and provide detailed records to the Contract Administrator.
- .6 HMI graphics are to be updated by the City to include the new CO alarm as required.

#### **4.6 BOILER COMMON HEADER TEMPERATURE**

- .1 A 4-20mA signal from TT-B502 shall be wired to the plant DCS for indication only.

**END OF SECTION**