

Part 1 General

1.1 GENERAL

- .1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.
- .2 Provide fully tested and operational mechanical systems in complete accordance with applicable codes and bylaws.
- .3 Contract documents of this section are diagrammatic and approximately to scale. Do not scale from the drawings, exact dimensions to be taken from architectural drawings or from the site. The drawings and specifications establish scope for material and installation quality and are not detailed installation instructions. Follow Manufacturer's recommendations for installation supplemented by contract documents, unless otherwise specified by the Contract Administrator. Any discrepancies must be brought to the Contract Administrator's attention in writing prior to the close of tenders.

1.2 SCOPE OF WORK

- .1 Work to include labour, material and equipment required for supplying, installing, testing, adjusting, balancing, commissioning mechanical systems and provision of As-built drawings, O & M manuals and personnel training as detailed in this and other Sections of Divisions 21, 22 & 23.
- .2 It is the responsibility of the General Mechanical Contractor to co-ordinate the work among the various sub-trades to ensure complete functioning systems.

1.3 DEFINITIONS

- .1 Wherever the term "Contract Administrator" is used in the Divisions 21, 22 & 23 drawings, and specifications it means:  

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- .2 Whenever "drawings" and "specifications" are referred to, it means "the Contract Documents".

1.4 WORK INCLUDED

- .1 Sections of these mechanical specifications are not intended to delegate functions or to delegate work and supply to any specific trade. The work shall include all labour,

materials, equipment, and tools required for a complete and working installation as described on the drawings and all Sections of Divisions 21, 22 & 23.

1.5 COMMISSIONING

- .1 Systems commissioning will be conducted prior to substantial completion. The purpose of the Commissioning is to ensure all systems are functioning as designed prior to substantial completion.
- .2 Commissioning will require the presence of knowledgeable representatives of the necessary Mechanical Trades. Manufacturer representatives are required to be on site for commissioning. The Mechanical Contractor shall include all necessary costs for systems commissioning. The Contract Administrator will participate to the extent deemed necessary.
- .3 All aspects of mechanical systems operations will be operated, checked, and verified. If any portion of the work fails to meet design requirements, the Commissioning procedure will be halted and only resumed when all necessary repairs are completed. All extra costs including costs for the Contract Administrator to revisit the site resulting from this postponement will be borne by this Contractor.
- .4 The Contractor shall submit, to the Contract Administrator, a commissioning report detailing the commissioning tests performed and the results of these tests. Format of report is to be one sheet for each piece of mechanical equipment, and it shall include: Equipment tag, description, location and point form description of tests and results. Submit blank draft commissioning test forms for each equipment to Contract Administrator for review prior to testing.
- .5 Contractor to provide seasonal commissioning as required. If heating or cooling systems can not be commissioned at the completion of the work due to outside weather conditions, the contractor is to return for the heating or cooling season to ensure the system is fully operational and functioning properly.

1.6 COMPLETION

- .1 After completing tests and adjustments remove temporary covers, and strainers, and obstructions to flow. Drain, flush and refill piping systems as often as required until all piping is clear of dirt and debris.
- .2 Leave Mechanical work in specified working order.
- .3 Provide spare components as specified in other Sections of Divisions 21, 22 & 23.
- .4 Provide one set of all specialized tools required to service equipment as recommended by manufacturers.

1.7 CONTRACT DRAWINGS AND SPECIFICATIONS

- .1 Drawings and specifications are complementary each to the other, what is called for by one shall be binding as if called for by both. Many items, such as valves, vents, thermometers, pressure gauges, etc. are shown only on schematics and are not shown on plan and elevation views. Provide and install all items shown in any or all of the drawings (or schematics).
- .2 Should any discrepancy appear between the drawings and specifications, which leave the Contractor in doubt as to the true intent and meaning of the plans, and specifications, the Contractor shall obtain a ruling from the Contract Administrator in writing before submitting a tender. If this is not done it will be assumed that the most expensive alternative has been included in the tender price. For any ruling to become binding, the Contract Administrator must issue the new direction in a published addendum.
- .3 Examine all contract documents, including all drawings, specifications, and work of other trades to ensure that work is co-ordinated and satisfactorily carried out without changes to the building or contract value.
- .4 The drawings for mechanical work are performance drawings. They are generally diagrammatic and are not to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions showing every offset, fitting, valve, or every difficulty encountered during execution of work and should not be used as an excuse for deficiencies or omissions.
- .5 Follow the recommended installation details and procedures for equipment as found in Supplier technical data, supplemented by contract document details.
- .6 Install piping, ductwork, etc., generally in the locations and routes shown on the drawings, close to the building structure to minimize furring and interference with other services or free space. Remove piping, ductwork, etc. that is not properly installed and replace to the satisfaction of the Owner/Contract Administrator at no additional cost.
- .7 Be completely responsible for the acceptable condition and operation of systems and equipment components forming part of the installation or associated with it. Promptly replace defective materials, parts and equipment and repair related damage.
- .8 The drawings are intended to convey the scope of work and indicate general arrangement and approximate location of apparatus and fixtures and indicate the general location and route to be followed by pipes and ducts. Where required installations are not shown on plans or are only shown diagrammatically, install in such a way as to conserve headroom and interfere as little as possible with free use of space through which they pass, while allowing adequate space for service, maintenance, repair, or replacement for all equipment.
- .9 All serviceable items, such as valves, controls, bearings, filters, and similar items, must be installed in such a manner as to be accessible for service, maintenance, repair and replacement without the removal of other material or equipment, and without the need for specialized equipment such as lifts, harnesses, or other safety items. Basically, work to be installed to allow easy equipment isolation and servicing functions while all surrounding systems continue to operate.

- .10 All individual pieces of equipment shall be provided with appropriate means of isolation and bypass so that systems may continue to operate during maintenance of individual components. It is understood that this may not be possible in all situations, but this is a requirement where isolation is possible.
- .11 Drawings and specifications to be considered as an integral part of contract documents and neither drawings nor specifications are to be used alone. Misinterpretation of requirements of plans or specifications shall not relieve Contractor of responsibility of properly completing work to approval of Contract Administrator.
- .12 Obtain information involving accurate dimensions from dimensions shown by site measurement. Visit and inspect the site of the work to verify location and elevation of existing services which may affect the Tender and work of this Division (water, electrical, sanitary, ductwork etc.) before submission of tender and proceeding with work. Make all necessary changes or additions to runs to accommodate structural conditions (pipes or ducts around beams, columns etc.) without additional expense to the Owner. Locations of pipes, ducts, and other equipment to be altered without charge to Owner, provided change is made before installation and does not necessitate additional materials and that all such changes are acceptable to the Contract Administrator and are suitably recorded on Record Set of Drawings.
- .13 Confirm on the site the exact location and mounting elevation of outlets and fixtures as related to existing Mechanical & Electrical components.
- .14 As work progresses and before installing piping, ductwork, fixtures and equipment interfering with interior treatment and use of building, consult Contract Administrator for appropriate action before proceeding. This applies to all levels and proper grading of piping. If Contractor fails to perform above checking and fails to inform Contract Administrator of such interference, Contractor to bear all subsequent expense to make good the installation.
- .15 Refer to Structural drawings for roof construction details. These shall relate to roof supports, piping penetrating roofs, etc. as indicated on mechanical detail sheets.
- .16 Alter, at no additional cost, the locations of materials and/or equipment as directed that do not necessitate additional material.

## 1.8 CUTTING AND PATCHING

- .1 Cutting, core drilling, patching and repairs to existing surfaces required as a result of the removal and/or relocation of existing equipment and piping, and/or installation of new equipment and piping to be included by Divisions 21, 22 & 23 - Mechanical in tender price. Divisions 21, 22 & 23 to employ and pay appropriate sub-trade whose work is involved, for carrying out work described above.
- .2 The cutting of openings not requiring lintels or other structural support will be the responsibility of the trade requiring the opening, the opening size will be the minimum

required, and that patching will be the responsibility of the trade making the opening to the original or specified conditions.

- .3 Where openings require lintels or other structural support, or roofing work, such openings will be specified under other divisions of this specification.

#### 1.9 PAINTING

- .1 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .2 Prime and paint marred finished paintwork to match original.
- .3 Restore to new condition finishes which have been damaged too extensively to be merely primed and touched up.
- .4 Painting of all new exposed ductwork and unexposed un-insulated piping by Section 09 91 00 - Painting.

#### 1.10 DOCUMENTATION AND SYSTEMS ACCEPTANCE

- .1 Provide the following on substantial performance of the work:
  - .1 As-Built drawings. As-built information is to be recorded as detailed elsewhere in this Section. Submit As-Built drawings to Contract Administrator for review prior to total completion.
  - .2 Assemble the specified quantity of O&M manuals in D-ring binders with index tabs, each containing this Sub-Contractor's and supplier's names and telephone numbers, data sheets, valve charts, brochures, operating, maintenance, and lubricating instructions as well as number coded wiring diagrams and a complete set of reviewed shop drawings for all equipment provided by this Division. Present all copies to the Contract Administrator for review.
  - .3 Extended warranty certificates, where specified in other Sections of Divisions 21, 22 & 23.
  - .4 Water balancing report. The work of Divisions 21, 22 & 23 will not be considered totally performed until acceptance by the Contract Administrator of the Air and Water Balancing Report.

#### 1.11 EQUIPMENT PROTECTION AND CLEANUP

- .1 Protect equipment and materials in storage on site, during and after installation until final acceptance. Leave factory covers in place and take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .2 Clean exposed surfaces of mechanical equipment, ductwork, piping, etc., and polish plated work.

- .3 Remove tools, surplus and waste material from the building site upon completion. Clean grease, dirt and excess material from walls, floors, ceilings, and fixtures for which this Contractor was responsible, and leave the premises suitable for immediate use.

#### 1.12 EXAMINATION OF THE SITE AND DOCUMENTATION

- .1 Prior to submitting tender, carefully examine site conditions, adjacent buildings, and local conditions at the site, which could affect the work of this Division.
- .2 Examine all contract drawings to ensure work can be performed without changes to the building, or work, as shown on plans. No allowance will be made later for necessary changes, unless notification of interferences has been brought to Contract Administrator's attention, in writing, prior to closing of tenders.
- .3 Verify that materials and equipment can be delivered to the place of the work and that sufficient space and access is available to permit installation thereof in locations shown on the drawings.

#### 1.13 GUARANTEES AND WARRANTIES

- .1 Guarantee satisfactory operation of all work and apparatus installed under this contract. Replace, at no expense to the Owner, all items, which fail or prove defective within a period of time as define in Division 1, but in no circumstances shall the warranty period be less than one (1) year after final acceptance of complete contract by the Owner. Make good all damage incurred as a result of failure or repair of mechanical work.
- .2 No certification given, payment made, partial or entire use of equipment by the Owner, shall be construed as acceptance of defective work or acceptance of improper materials. Make good at once, without cost to the Owner, all such defective work or materials and consequence resulting, within the period of time defined in Division 1, but not less than one (1) year from time of final acceptance date.
- .3 This general guarantee shall not act as a waiver for any specified guarantee and/or warranty of greater length of time noted elsewhere in these documents.
- .4 Comply with requirements of Division 1. Where warranties specified in Division 1 are longer, or more stringent than in Divisions 21, 22 & 23, Division 1 shall govern. Provide warranties on specified products, equipment, and components as well as on the installation of these items. Include for all costs for cutting and patching, removals and restoration materials and work and repairs to other equipment affected in performance of warranty work.
- .5 Provide warranty certificates, wherever given or required, that are in excess of the normal warranty period showing the name of the firm giving the warranty, dated and acknowledged, on specific equipment and system.

#### 1.14 INSTRUCTIONS TO THE OWNER

- .1 At the completion of the work, the Contractor shall instruct and demonstrate to the Owner's employee(s), or owner's representative, who will have charge of the equipment, the operation, maintenance care, and adjustment of all parts of the system to satisfaction of Contract Administrator.
- .2 Demonstrate the specific starting, stopping, controlling and general maintenance requirements for each major piece of equipment and system.
- .3 Demonstrate all mechanical systems and provide a Contractor guided tour of the facility to point out all locations of equipment, dampers, control devices and the like.
- .4 Manufacturer's representative to provide training for operational staff, minimum of two separate four (4) hour training sessions.

1.15 LIABILITIES

- .1 Install concealed pipes and ducts neatly, close to building structure so furring is minimum size. Pipes, ducts, and equipment installed improperly, to be removed and replaced without cost to Owner.
- .2 Co-ordinate work with other sections to avoid conflict and to ensure proper installation of all equipment. Review all contract drawings.

1.16 MECHANICAL SUB-TRADES

- .1 Submit, with the tender, the names of all Sub-Trades to be used on this project as well as the extent of work to be performed by each.
- .2 Contractor to have minimum five years experience in field of mechanical contracting and to have successfully performed work of similar nature and approximate size to that indicated in specifications and on drawings.

1.17 OPERATING AND MAINTENANCE MANUALS

- .1 Provide O & M Manuals to the Contract Administrator for review two (2) weeks prior to final inspection. Incorporate Contract Administrator's review comments into final copies.
- .2 Provide three (3) sets of manuals in separate 3 "D" ring, loose leaf binders with spine and face pockets, with the project name clearly indicated on the spine and face. The final accepted copies shall be provided to the Owner.
- .3 General catalogue data for the Operations and Maintenance Manual is unacceptable. If manufacturer's specification sheets are generalized in any way, they shall be clearly marked to show exactly which item has been supplied, and the project designation for that item (e.g., PRV-1) is to be noted on Manufacturer's specification sheet which includes all details for this unit, including complete model number, serial number, and construction & performance data.

- .4 The outline for the Operating & Maintenance Manual shall be as follows:
  - Contractor and Sub-Contractor Contact Information
  - Purpose
  - General Description
  - Operating Instructions
  - Seasonal Operations
  - Normal Valve Positions and Control
  - Recommended Inspection and Preventative Maintenance
  - Maintenance Schedule
  - Description of Maintenance Procedures
  - Recommended Major Equipment Spare Parts List
  - Appendices
  - Equipment Shop Drawings
  - Equipment Supplier Schedule
  - Manufacturer Recommended O & M Information
  - Exploded Views and Parts Lists
  - As-Built Drawings (reduced)
  - Control Narrative
  - Control Drawings
- .5 Include the following information in the manuals, incorporated into the outline format above, as applicable:
  - .1 Mechanical Systems
    - .1 Maintenance Tasks - including daily, weekly, monthly, semi-annual, and annual checks.
    - .2 Lubrication Information.
    - .3 List of Contractors and Equipment Suppliers including contact information
    - .4 Parts and Troubleshooting Information.
  - .2 Certification and Identification
    - .1 Inspection Certificates
    - .2 Balance Reports
  - .3 Component Information
    - .1 Section for each type of equipment to include shop drawings, installation, and maintenance information.
  - .4 Safety Information
  - .5 Also provide the following information:
    - .1 Include control diagrams, (including Building Automation System diagrams), sequence of operations, and service instructions (calibration, trouble shooting, etc.).



- .2 Provide Manufacturer's preventive maintenance procedures (recommended lubrication materials and procedures, frequency, etc.).
- .3 System and equipment troubleshooting guides.
- .4 A copy of the final balancing reports.

1.18 PERFORMANCE OF WORK

- .1 Protect and maintain work until work has been completed and accepted. Protect work against damage during installation. Cover with tarpaulins if necessary. Repair all damage to floor and wall surfaces resulting from carrying out of work, without expense to the Owner.

1.19 PERMITS, FEES AND INSPECTIONS

- .1 Apply for, obtain, and pay for all permits, licences, inspections, examinations, and fees required for work of Divisions 21, 22 & 23.
- .2 Review drawings with authorities having jurisdiction to ensure compliance with all applicable codes and by-laws.
- .3 In case of conflict, codes and regulations take precedence over the contract documents. In no instance reduce the standard or scope of work or intent established by the drawings and specifications by applying any of the codes referred to herein. Any discrepancies must be brought to the Contract Administrator's attention in writing.
- .4 Before starting any work submit the required number of copies of drawings and specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the contract but notify the Contract Administrator immediately of such changes. Prepare and submit any additional drawings, details or information as may be required.

1.20 AS-BUILT DRAWINGS

- .1 Obtain one set of drawings and specifications and, as the job progresses, mark these prints clearly in red pencil to accurately indicate installed work, as well as alterations to ductwork, piping, equipment and associated work changes and deviations from work shown on Contract Drawings, including all Addenda and Work Order Changes.
- .2 As-Built drawings to be maintained on a continuous basis to ensure they are up-to-date and accurate and always have current prints available for inspection at the site.
- .3 Submit this set of record drawings to the Contract Administrator for review on completion of the work. Should the record drawings be lacking information or details of changes made, they will be returned to the contractor. The contractor is to, without additional cost to the Owner or Contract Administrator, make the required site inspections, etc. and update the record drawings to the satisfaction of the Contract Administrator.

1.21 REGULATORY REQUIREMENTS

- .1 Comply with the most stringent requirements of all Municipal, Provincial and Federal Bylaws and Ordinances, the requirements of Utilities such as Manitoba Hydro, and all sections of this specification.
- .2 Provide necessary notices, obtain permits, and pay all fees, in order that work specified may be carried out.
- .3 Furnish certificates confirming work installed conforms to requirements of authorities having jurisdiction.

1.22 SHOP DRAWINGS

- .1 Submit to the Contract Administrator for review a maximum of four (4) sets of detailed shop drawings. Electronic .pdf format shop drawings are acceptable.
- .2 Check shop drawings for conformity to plans and specifications prior to submission.
- .3 Submit shop drawings for all items specified in the sections of Divisions 21, 22 & 23. For equipment, provide performance, physical and operating data as described in the Specifications and listed in equipment schedules. Provide performance curves for all pumps and fans.
- .4 Shop drawings shall include copies of applicable brochure or catalogue material clearly indicating manufacturer and model. Ambiguous shop drawings will not be reviewed.
- .5 Clearly mark submittal to indicate all differences from the specified material. The Contract Administrator will require all options and material indicated on the shop drawing to be provided and installed. Specifically note on the submittal specified features such as tank linings, pump seal materials, painting finish, etc.
- .6 Include dimensional and technical data sufficient to determine if equipment meets requirements, including weights, loading points, electrical data, and motor sizes.
- .7 Identify the equipment by system name and number, e.g. " S1, Second Floor, Air Supply Fan", "P1, Chilled Water Pump", etc.
- .8 Installed materials and equipment shall meet specified requirements regardless of whether or not the shop drawings were reviewed by the Contract Administrator.
- .9 Each drawing to include name of project, equipment supplier and clause number equipment is specified under.
- .10 Clearly show division of responsibility. No item, equipment or description of work shall be indicated to be supplied or work to be done "By Others" or "By Purchaser". Any item, equipment or description of work shown on shop drawings shall form part of contract, unless specifically noted to contrary.

- .11 Take full responsibility for securing and verifying field dimensions. In cases where fabrication must proceed prior to field dimensions being available, check all shop drawings and approve for dimensions only. In this case guarantee that dimensions will be worked to and ensure that other sub-trades are aware of these dimensions and shall comply with them.
  - .12 Review by Contract Administrator shall be mutually understood to refer to general design only. If errors in detailed dimensions or interference with work are noticed, attention of Contractor will be called to such errors of interferences, but Contract Administrator's review of drawings will not in any way relieve Contractor from responsibility for said errors or interferences, or from necessity of furnishing such work, and materials as may be required for completion of work as called for in contract documents.
  - .13 This review by the Contract Administrator is for the sole purpose of ascertaining conformance with the design concept.
  - .14 Do not order equipment until the Contract Administrator has reviewed and returned the reviewed shop drawings.
  - .15 Keep one set of shop drawings on the site.
  - .16 Bind one complete set of checked shop drawings in each operating and maintenance instruction manual.
- 1.23 SITE REVIEW
- .1 The Contractor's work will be reviewed periodically by the Owner, Contract Administrator, or their representatives, solely for the purpose of determining general quality of work. Guidance will be offered to Contractor in interpretation of plans and specifications as assistance to carry out work.
  - .2 Reviews and directives given to Contractor, his agents, servants, and employees does not relieve the Contractor, his agents, servants or employees of their responsibility to provide the work in all its parts in a safe and workmanlike manner, and in accordance with plans and specifications, nor impose on Owner, and/or Contract Administrator or their representatives, any responsibility to supervise or oversee erection or installation of any work.
- 1.24 SPECIAL TOOLS AND SPARE PARTS
- .1 Furnish the Owner with spare parts as follows:
    - .1 Spare parts as detailed in individual Sections of Divisions 21, 22 & 23.
- 1.25 STANDARDS

- .1 Conform to the best modern practices of workmanship and installation methods and employ only skilled tradesmen working under the direction of fully qualified personnel.

1.26 STANDARD OF MATERIAL

- .1 All materials and equipment installed under this contract shall be new unless otherwise noted.
- .2 Materials and equipment specified, and acceptable manufacturers are named in this specification for the purpose of establishing the standard of materials and workmanship to which Contractor shall adhere. Tender price shall be based on the use of materials and equipment as specified.
- .3 Provide new material and equipment of first class quality, delivered, erected, connected and finished in every detail, and supplied with the acceptance of the Contract Administrator. Assume responsibility of ensuring that provided equipment performs as specified.
- .4 In the preparation of the tender, if a Sub-Contractor neglects to name the manufacturer where accepted equals have been shown, it will be understood that the specified equipment will be provided.
- .5 Requests for approval of equals must be submitted not less than seven days prior to closing date of the tender, and submissions must bear proof of acceptance by the Owner or Contract Administrator if used in the tender.
- .6 Assume full responsibility for ensuring that, when providing accepted equals, all space, weight, connections, power, and wiring requirements, etc. are considered and adjusted costs are included in the tender. Alternative equipment requiring greater than specified energy requirements or unduly limiting service space requirements will not be accepted.
- .7 All additional costs for mechanical, electrical, structural, and architectural revisions required to incorporate materials accepted as an equal and substituted by Contractor shall be responsibility of Contractor.
- .8 Equipment listed as "equal" in specifications or submitted as equal by the Contractor must meet all space requirements, specified capacities and must have equipment characteristics of specified equipment as interpreted by Contract Administrator. Install equipment in strict accordance with Manufacturer's published recommendations.

1.27 SUBSTANTIAL COMPLETION

- .1 Prior to requesting any substantial completion inspection, complete all of the following items:
  - .1 All systems shall be operational with alarms, interlocks, and control functions.
  - .2 Obtain all certificates of approval from the authorities having jurisdiction.

- .3 All manufacturer start-ups shall be complete.
- .4 Complete valve tagging and identification of all new mechanical systems and components.
- .5 Lubricate all equipment as per manufacturers' instructions.
- .6 Submit O & M Manuals and perform operator training.
- .7 Provide all Manufacturers' reports required by specifications.
- .8 Complete System Commissioning.
- .9 Complete all previously identified deficiencies.
- .10 Clean equipment both inside and out.
- .11 Complete final air and water balancing and submit reports.
- .12 Complete final calibration.
- .13 Provide As-Built record drawings in accordance with the tender documents.

1.28 SUPERINTENDENCE

- .1 Maintain qualified job site personnel consisting of licensed tradesmen and registered apprentices with proven experience in erecting, supervising, testing, and adjusting projects of comparable nature and complexity.

1.29 TEMPORARY USE OF EQUIPMENT

- .1 Permanent systems and/or equipment not to be used during construction period, without the Owner's permission.
- .2 Temporary use of equipment shall in no way relieve Contractor of providing warranties, as described elsewhere in this Section and in Division 1, on all equipment and systems so used.
- .3 Operate systems under conditions that ensure no temporary or permanent damage. Operate systems with proper treatment. Operate fans at proper resistance with filters installed. Change filters at regular intervals and prior to final acceptance. Operate with proper safety devices and controls installed and fully operational.
- .4 Under no circumstances shall air handling units, heat recovery ventilators or other air systems be used to provide temporary heating, cooling, or ventilation during construction. Air systems (air handling units and heat recovery ventilators) shall only be operated after all drywall sanding and carpet installation (or any other operation that creates considerable dust or fibres) is complete.

1.30 WELDING REGULATIONS

- .1 Welding shall be performed by welder holding current welder's certificate from Provincial Department of Labour.

- .2 Suitable fire extinguishers are to be present during welding operations and during fire watch period.
  - .3 During welding or soldering ensure structure is protected against fire, shield with fire-rated sheets and galvanized iron sheets.
  - .4 Proper ventilation shall be provided during welding operations. A fume extraction system shall be used for welding operations taking place indoors.
  - .5 Maintain a fire watch for a minimum of 1 hour after welding operations are complete.
- 1.31 WORKMANSHIP
- .1 Only first class workmanship will be accepted, not only as regards to safety, efficiency, and durability but also as regards to neatness of detail. Pipework must be installed parallel to, or at right angles to building planes. The entire work shall present a neat and clean appearance on completion.
- Part 2 Products
- .1 NOT USED.
- Part 3 Execution
- 3.1 PAINTING REPAIRS AND RESTORATION
- .1 Do painting in accordance with Section 09 91 00 - Painting.
  - .2 Prime and touch up marred finished paintwork to match original.
  - .3 Restore to new condition, finishes which have been damaged.
- 3.2 CLEANING
- .1 Clean interior and exterior of all systems including strainers.
- 3.3 DEMONSTRATION
- .1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
  - .2 Supply tools, equipment, and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, troubleshooting, and servicing of all systems and equipment during regular work hours, prior to acceptance.
  - .3 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.
  - .4 Contractor shall record these demonstrations on video tape for future reference.
- END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
  - .1 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2 CSA International
  - .1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
  - .2 CSA B79, Commercial and Residential Drains and Cleanouts.
- .3 Efficiency Valuation Organization (EVO)
  - .1 International Performance Measurement and Verification Protocol (IPMVP).
    - .1 IPMVP Version.
- .4 Plumbing and Drainage Institute (PDI)
  - .1 PDI-WH201, Water Hammer Arresters Standard.

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 plumbing products and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions: submit manufacturer's installation instructions.
- .5 Manufacturers' Field Reports: manufacturers' field reports specified.

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 plumbing specialties and accessories for incorporation into manual.
  - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year, and capacity.
  - .2 Details of operation, servicing, and maintenance.
  - .3 Recommended spare parts list.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect plumbing materials from damage.
  - .3 Replace defective or damaged materials with new.
- .4 Waste Management: In accordance with Section 01 74 21 - Construction Waste Management.

## Part 2 Products

### 2.1 GREASE INTERCEPTOR (GI-1)

- .1 Seamless molded polyethylene with minimum 5/16" uniform wall thickness. Inlet diffuser cap shall be PVC. Interceptor shall be furnished for below-grade installation. Unit shall be certified for hydromechanical performance to ASME A112.14.3 (Type D) and CSA B481.1. Interceptor flow rate shall be 35 GPM. Interceptor grease capacity shall be 119.3 lbs (16.3 gal) @ 35 GPM. Cover shall provide water/gas-tight seal and have a minimum of 450 lbs load capacity.
- .2 Acceptable Product: "Schier" model GB2 or approved equal.

### 2.2 BACKFLOW PREVENTERS

- .1 Double Check Valve:
  - .1 The Double Check Backflow Prevention Assembly shall be certified to NSF/ANSI 372, ASSE® Listed 1015, FM approved and supplied with butterfly valves. The main body and access cover shall be epoxy coated ductile iron (ASTM A 536 Grade 4), the seat ring and check valve shall be NORYL™, the stem shall be stainless steel (ASTM A 276) and the seat disc elastomers shall be EPDM. The checks shall be accessible for maintenance without removing the device from the line.
  - .2 Acceptable Product: ZURN WILKINS Model 350A BG or approved equal.
- .2 Reduced Pressure Zone Type:
  - .1 The assembly shall consist of an internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seat discs. Seats and seat discs shall be replaceable in both check modules and the relief valve. There shall be no threads or screws in the waterway exposed to line fluids. Service of all internal components shall be through a single access bronze cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves, four resilient seated test cocks and an air gap drain fitting. The assembly shall meet the requirements of: USC; ASSE Std. 1013; AWWA Std. C511-92; CSA B64.4.



- .2 Acceptable Product: Watts Series 009 or approved equal.
- 2.3 CLEANOUTS
  - .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
  - .2 Access Covers:
    - .1 Wall Access: face or wall type, stainless steel square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
    - .2 Floor Access: rectangular or round cast iron body and frame with adjustable secured nickel bronze top and:
      - .1 Plugs: bolted bronze with neoprene gasket.
      - .2 Cover for Unfinished Concrete Floors: cast iron square, gasket, vandal-proof screws.
      - .3 Cover for Terrazzo Finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.
      - .4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
      - .5 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.
- 2.4 WATER HAMMER ARRESTORS
  - .1 Copper construction, piston type: to PDI-WH201.
- 2.5 VACUUM BREAKERS
  - .1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric.
- 2.6 STRAINERS
  - .1 Wye-pattern lead free cast copper silicon alloy body and retainer cap tapped for closure plug, EPDM cap gasket and soldered connections. Strainer shall have standard 304 stainless steel standard #20 mesh screen. Rated pressure of 27.6 bar (400 psi) WOG @ 99°C (210°F).
  - .2 Acceptable product: "Watts" model LFS777 strainer or approved equal.
- 2.7 TRAP SEAL PRIMERS
  - .1 Brass, with integral vacuum breaker, 13 mm (NPS 1/2) solder ends, 13 mm (NPS 1/2) drip line connection.
- 2.8 TRAP SEAL PRIMER MANIFOLDS
  - .1 Metal cabinet 12"x12"x4" NEMA-1 with cover plate and 16 gauge steel cover.

- .2 ¾" inlet NPT female complete with shut off ball valve, ½" compression fitting outlet.
- .3 ¾" copper Type L manifold tubing.
- .4 Anti-siphon atmospheric vacuum breaker.
- .5 Temperature rating 32F – 125F and Pressure rating of 20-150 PSI.
- .6 Electrical: 120V/60, Power 6 Watts
- .7 Controls: 24 hour timer with manual override switch/test button and 2 AMP circuit breaker.
- .8 Solenoid Valve: UL Listed.
- .9 Contractor to verify exact number of drains served prior to order.
- .10 Coordinate power requirements for all trap priming manifolds with Division 26.
- .11 Acceptable product: "Precision Plumbing Products" Model Prime Time Electric Trap Priming Assembly

## 2.9 BALL VALVES

- .1 50 mm (NPS 2") and under, threaded:
  - .1 Class 150
  - .2 Lead Free
  - .3 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle
- .2 50 mm (NPS 2") and under, soldered:
  - .1 To ANSI/ASME B16.18, Class 150
  - .2 Lead Free
  - .3 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors

## 2.10 SWING CHECK VALVES

- .1 50 mm (NPS 2") and under, threaded:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.
- .2 50 mm (NPS 2") and under, screwed:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.
- .3 50 mm (NPS 2") and under, screwed:
  - .1 Class 150.
  - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle.

- .4 50 mm (NPS 2") and under, soldered:
  - .1 To ANSI/ASME B16.18, Class 150
  - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors.
- 2.11 PRESSURE REDUCING VALVE (PRV)
  - .1 Designed to reduce pressure up to 2068 kPa (300 psi) and may be adjusted from 172-517 kPa (25-75 psi).
  - .2 Lead free construction.
  - .3 Sealed spring cage and stainless-steel corrosion resistant adjusting cage screws.
  - .4 Union inlet connection.
  - .5 Integral stainless-steel strainer.
  - .6 Replaceable seat module.
  - .7 In-line serviceability.
  - .8 Temperature range 1°C-82°C (33°F-180°F).
  - .9 Premises isolation: reduced pressure zone assembly.
  - .10 Acceptable product: "Watts" Model LF25AUB-Z3 or approved equal.
- 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 plumbing specialties and accessories 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 MANUFACTURER'S INSTRUCTIONS
  - .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.
- 3.3 INSTALLATION
  - .1 Install in accordance with Manitoba Plumbing Code.
  - .2 Install in accordance with manufacturer's instructions and as specified.

3.4 CLEANOUTS

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.5 WATER HAMMER ARRESTORS

- .1 Install on branch supplies to fixtures or group of fixtures.

3.6 TRAP SEAL PRIMERS

- .1 Install for floor drains and elsewhere, as indicated.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Contract Administrator.
- .3 Install plastic tubing to floor drain.

3.7 BACKFLOW PREVENTERS

- .1 Install in accordance with CSA B64 Series, where indicated and elsewhere as required by code.
- .2 Pipe discharge to terminate over nearest drain or service sink.

3.8 STRAINERS

- .1 Install with sufficient room to remove basket for maintenance.

3.9 PRESSURE TANKS

- .1 Adjust pre-charge pressure to setting as scheduled or as directed by the Contract Administrator.

3.10 START-UP

- .1 General:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
- .2 Timing: start-up only after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.

3.11 TESTING AND ADJUSTING

- .1 General:
  - .1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13- General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
- .2 Timing:
  - .1 After start-up deficiencies rectified.
  - .2 After certificate of completion has been issued by authority having jurisdiction.
- .3 Floor drains:
  - .1 Verify operation of trap seal primer.
  - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
  - .3 Check operations of flushing features.
  - .4 Check security, accessibility, removability of strainer.
  - .5 Clean out baskets.
- .4 Vacuum breakers, backflow preventers, backwater valves:
  - .1 Test tightness, accessibility for O M of cover and of valve.
  - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
  - .3 Verify visibility of discharge from open ports.
- .5 Access doors:
  - .1 Verify size and location relative to items to be accessed.
- .6 Cleanouts:
  - .1 Verify covers are gas-tight, secure, yet readily removable.
- .7 Water hammer arrestors:
  - .1 Verify proper installation of correct type of water hammer arrester.
- .8 Pressure regulators, PRV assemblies:
  - .1 Adjust settings to suit locations, flow rates, pressure conditions.
- .9 Strainers:
  - .1 Clean out repeatedly until clear.
  - .2 Verify accessibility of cleanout plug and basket.
  - .3 Verify that cleanout plug does not leak.

3.12 DOMESTIC WATER METER AND SUB WATER METERS

- .1 Provide the following testing and adjusting for the water meter installation.
  - .1 Verify location and accessibility.

.2 Test meter reading accuracy.

3.13 CLEANING

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

3.14 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .2 ASTM C449, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .3 ASTM C547, Mineral Fiber Pipe Insulation.
  - .4 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2 CGSB 51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .3 Thermal Insulation Association of Canada (TIAC)
  - .1 TIAC Mechanical Insulation Best Practices Guide.
- .4 Underwriters Laboratories of Canada (ULC)
  - .1 ULC 102, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 ULC 702, Thermal Insulation, Mineral Fibre, for Buildings

1.2 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 Codes:
  - .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, and datasheet. Include product characteristics, performance criteria, and limitations.
  - .2 Submit copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS).

- .3 Quality assurance submittals:
  - .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.
- 1.4 QUALITY ASSURANCE
  - .1 Qualifications: Installer to be specialist in performing work of this Section and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.
- 1.5 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 Dispose of waste materials in accordance with Section 01 74 21 – Construction/ Demolition Waste Management and Disposal.
  - .4 Place materials defined as hazardous or toxic in designated containers.
- Part 2 Products
  - 2.1 FIRE AND SMOKE RATING
    - .1 In accordance with ULC 102.
      - .1 Maximum flame spread rating: 25.
      - .2 Maximum smoke developed rating: 50.
  - 2.2 INSULATION
    - .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
    - .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
    - .3 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
      - .1 Mineral fibre: to ULC 702 and ASTM C547.
      - .2 Jacket: to CGSB 51-GP-52Ma.
      - .3 Maximum "k" factor: to ULC 702 and ASTM C547.
  - 2.3 INSULATION SECUREMENT
    - .1 Tape: self-adhesive, aluminum, reinforced, 50mm wide minimum.
    - .2 Contact adhesive: quick setting.
    - .3 Canvas adhesive: washable.



- .4 Tie wire: 1.5mm diameter stainless steel.
- .5 Bands: stainless steel, 19mm wide, 0.5mm thick.
- 2.4 CEMENT
  - .1 Thermal insulating and finishing cement:
    - .1 Hydraulic setting on mineral wool, to ASTM C449.
- 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 JACKETS
  - .1 Polyvinyl Chloride (PVC):
    - .1 One-piece moulded type and sheet to CGSB 51.53 with pre-formed shapes as required.
    - .2 Colours: to match adjacent finish paint.
    - .3 Minimum service temperatures: -20°C.
    - .4 Maximum service temperature: 65°C.
    - .5 Moisture vapour transmission: 0.02 perm.
    - .6 Thickness: 30 mil
    - .7 Fastenings:
      - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
      - .2 Tacks.
      - .3 Pressure sensitive vinyl tape of matching colour.
    - .8 Special requirements:
      - .1 Outdoor: UV rated material at least 0.5 mm thick.
  - .2 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.
- 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.

- 3.2PRE-INSTALLATION REQUIREMENT
- .1Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2Surfaces clean, dry, free from foreign material.
- 3.3INSTALLATION
- .1Install in accordance with TIAC National Standards.

.2Apply materials in accordance with manufacturer’s instructions and this specification.

.3Use two layers with staggered joints when required nominal wall thickness exceeds 75mm.

.4Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1Install hangers, supports outside vapour retarder jacket.

.5Supports, Hangers:

.1Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.
- 3.4INSTALLATION OF ELASTOMERIC INSULATION
- .1Insulation to remain dry. Overlaps to manufacturer’s instructions. Ensure tight joints.

.2Provide vapour retarder as recommended by manufacturer.
- 3.5PIPING INSULATION SCHEDULES
- .1Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2TIAC Code: A-3.

.1Securements: SS bands at 300mm on centre.

.2Seals: VR lap seal adhesive, VR lagging adhesive.

.3Installation: TIAC Code: 1501-C.

.3Thickness of insulation as listed in following table.

.1Run-outs to individual units and equipment not exceeding 4000 mm long.

.2Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
		Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
Domestic Cold Water Supply	A-3	25	25	25	25	25	25
Domestic Hot Water Supply	A-3	25	25	25	25	25	25
Domestic Hot Water Return	A-3	25	25	25	25	25	25

- .4Finishes:

- .1 Exposed indoors: PVC 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 screws, at 150mm on centre. Seals: wing.
- .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

### 3.6 CLEANING

- .1 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 Section Includes:

- .1 Materials and installation for plumbing pumps.

1.2 REFERENCES

.1 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.

.2 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.

.3 Shop Drawings.

.1 Submit shop drawings to indicate:

- .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.
- .2 Wiring and schematic diagrams.
- .3 Dimensions and recommended installation.
- .4 Pump performance and efficiency curves.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturers' Field Reports: manufacturers' field reports specified.

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

- .1 Manufacturers name, type, model year, capacity, and serial number.
- .2 Details of operation, servicing, and maintenance.
- .3 Recommended spare parts list with names and addresses.

Part 2 Products

2.1 DOMESTIC HOT WATER RECIRCULATION PUMP (RP-1):

- .1 Refer to equipment schedules on drawings for performance requirements.

- .2 Type: Pumps shall be of horizontal system lubricated type specifically designed and guaranteed for quiet operation, maximum operating temperature of 107°C (225°F) and maximum operating pressure of 1035 kPa (150 psig).
  - .3 Motor: Non-overloading at any point on pump curve, built-in thermal protection, motor stator to be isolated from circulating fluid, rotor to be sheathed in stainless steel.
  - .4 Construction: Pump body shall be lead-free bronze, ceramic shaft supported by carbon bearings, bearings to be lubricated by the circulating fluid.
  - .5 Electrical: Refer to equipment schedules on drawings.
  - .6 Automatic timer and aquastat pump control:
    - .1 The automatic timer kit and aquastat shall be combined to provide automatic time and temperature control to the circulator pump.
    - .2 When the automatic timer and the aquastat are used together, the pump will only circulate water when the ON time conditions are met and when the water temperature is low enough to cause the aquastat to switch ON.
    - .3 Automatic timer kit:
      - .1 Timer kit shall be UL approved.
      - .2 Timer kit shall be installed on the connection box of the circulator pump.
      - .3 Timer kit will be suitable for 115V/120V, 1 PH, 60 Hz operation.
      - .4 Timer shall provide automatic ON-OFF control at minimum interval of every 15 minutes. It shall also have the option of providing manual ON-OFF control.
      - .5 Acceptable Product: Bell & Gossett model TC-1 or approved equal.
    - .4 Aquastat:
      - .1 Aquastat shall be UL approved.
      - .2 Aquastat shall be connected to the lead wires in the connection box of the circulator pump.
      - .3 Aquastat will be suitable for 115V/120V, 1 Ph, 60 Hz operation.
      - .4 Aquastat shall provide thermostat control to the circulator. It will turn OFF (open) at 48.9°C (120°F) and ON (closed) at 37.8°C (100°F). The use of insulation in installation with excessive heat or colling may be necessary. Use of fiberglass insulation with R-values greater than 1.6 are recommended.
      - .5 Confirm pipe size prior to ordering for aquastat clips.
      - .6 Acceptable Product: "Bell & Gossett" model AQS-1/2 / AQS-3/4 or approved equal.
  - .7 Acceptable Product: As indicated on Equipment Schedule.
- 2.2 CONDENSATE PUMP (CP-1):
- .1 Refer to equipment schedules on drawings for performance requirements.

- .2 Maximum BTUs: 49,500
- .3 Maximum water temperature: 104 °F
- .4 With remote reservoir.

### 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 data sheet.

#### 3.2 INSTALLATION

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .2 Ensure pump and motor assembly do not support piping.
- .3 Align vertical pit mounted pump assembly after mounting and securing cover plate.

#### 3.3 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
  - .1 Check power supply.
  - .2 Check starter protective devices.
- .2 Start-up, check for proper and safe operation.
- .3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature, and other protective devices.
- .4 Adjust flow from water-cooled bearings.
- .5 Adjust impeller shaft stuffing boxes, packing glands.

#### 3.4 START-UP

- .1 General:
  - .1 Procedures:
    - .1 Check power supply.
    - .2 Start pumps, check impeller rotation.
    - .3 Check for safe and proper operation.
    - .4 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.
    - .5 Test operation of hands-on-auto switch.
    - .6 Test operation of alternator.
    - .7 Adjust leakage through water-cooled bearings.

- .8 Adjust shaft stuffing boxes.
- .9 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.
- .10 Check base for free-floating, no obstructions under base.
- .11 Run-in pumps for twelve (12) continuous hours.
- .12 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
- .13 Adjust alignment of piping and conduit to ensure full flexibility.
- .14 Eliminate causes of cavitation, flashing, air entrainment.
- .15 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .16 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .17 Verify lubricating oil levels.

### 3.5 REPORTS

- .1 Include:
  - .1 Product Information report forms.
  - .2 Pump performance curves (family of curves) with final point of actual performance.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 All valves, piping, fittings, solder, and accessories shall contain no lead to be in conformance with latest edition of NSF 61 Drinking Water System Components – Health Effects.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)
  - .1 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250.
  - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ANSI/ASME B16.22, Wrought Copper, and Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International Inc.
  - .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2 ASTM A536, Standard Specification for Ductile Iron Castings.
  - .3 ASTM B88M, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
  - .1 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International)
  - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-67, Butterfly Valves.
  - .2 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .8 National Research Council (NRC)/Institute for Research in Construction
  - .1 NRCC 38728, National Plumbing Code of Canada (NPC).
- .9 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).



1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
  - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.
- .2 Buried or embedded:
  - .1 Copper tube, soft annealed, type L: to ASTM B88M, in long lengths and with no buried joints.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 (50 mm) and larger: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
- .6 NPS 1 (25 mm) and smaller: wrought copper to ANSI/ASME B16.22; Suitable for operating pressure to 1380 kPa.

2.3 JOINTS

- .1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head, and washers: to ASTM A307, heavy series.
- .3 Solder: 95/5 tin copper alloy.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.

- .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

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 in accordance with Manitoba Plumbing Code.
- .2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install Domestic Cold Water (DCW) piping below and away from Domestic Hot Water (DHW) and Domestic Hot Water Recirculation (DHWR) and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Buried tubing:
  - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
  - .2 Bend tubing without crimping or constriction. Minimize use of fittings.

3.3 VALVES

- .1 Isolate equipment, fixtures, and branches with ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.4 PRESSURE TESTS

- .1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.
- .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa (125 psi).

3.5 FLUSHING AND CLEANING

- .1 Flush entire system for eight (8) hours. Ensure outlets flushed for two (2) hours. Let stand for twenty-four (24) hours, and then draw one sample off longest run. Submit to testing laboratory to verify that system is clean. Let system flush for additional two (2) hours, then draw off another sample for testing.

3.6 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

3.7 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.
- .2 Upon completion, provide laboratory test reports on water quality for approval.

3.8 START-UP

- .1 Timing: start up after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems are operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
  - .1 Establish circulation and ensure that air is eliminated.
  - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
  - .3 Monitor piping of DHW and DHWR piping systems for freedom of movement, pipe expansion as designed.
  - .4 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.9 OPERATION REQUIREMENTS

- .1 Co-ordinate operation and maintenance requirements including cleaning and maintenance of specified materials and products with Section 23 05 05 - Installation of Pipework.

3.10 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International Inc.
  - .1 ASTM D2564, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-Series B1800, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-36, Commercial Adhesives.

1.2 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.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Store at temperatures and conditions recommended by manufacturer.

Part 2 Products

2.1 MATERIAL

2.2 PIPING AND FITTINGS

- .1 Sanitary Sewer - For buried and above ground:
  - .1 PVC-DWV piping to CAN/CSA B1800.
  - .2 PVC XFR, SCH 40 where located in return air plenums.
    - .1 Maximum flame spread rating: 25.
    - .2 Maximum smoke developed rating: 50.
- .2 Sump and Sewage Pump discharge piping:
  - .1 PVC, SCH. 40.

2.3 BACKWATER VALVE

- .1 Dura-coated cast iron body with no-hub inlet and outlet, gasketed bolted cover, automatic PVC flapper type with o-ring.

2.4 JOINTS

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

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 Manitoba Plumbing Code.
- .3 All roof penetrations for plumbing venting shall use Thaler cones. Spun aluminum is not acceptable.

3.3 BACKWATER VALVES

- .1 Install where indicated.
- .2 Install in access pit as indicated.

3.4 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.
- .3 Pumped Sewage and Sump Pump Discharge Piping - subject piping to a hydrostatic pressure of at least 414 kPa (60 psi) but not less than 1-1/2 times the operating pressure of the system for a period of at least two (2) hours. If leaks are detected, such leaks shall be repaired, and the test started over. Exception - Piping subject to freezing or located above sensitive area or equipment shall be tested with oil-free air in lieu of water.

3.5 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 CSA B51-03(R2007), Boiler, Pressure Vessel, and Pressure Piping Code.
  - .2 CAN/CSA C22.2 No.110-94(R2004), Construction and Test of Electric Storage Tank Water Heaters.
  - .3 CAN/CSA-C191-04, Performance of Electric Storage Tank Water Heaters for Household Service.
  - .4 CAN/CSA-C309-M90(R2003), Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.
- .2 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada 2015(NPC).

1.2 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 domestic water heater, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
  - .1 Indicate:
    - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00- Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 COMPONENTS

.1 Sustainable Requirements:

- .1 Materials and products in accordance with Section 01 47 15- Sustainable Requirements: Construction.

2.2 DOMESTIC HOT WATER TANK (DWH-1 & DWH-2)

- .1 Performance: Refer to schedule on Mechanical Equipment Schedules Drawing.
- .2 Commercial hybrid system shall include combined condensing tankless water heater and storage tank.
- .3 Tankless Water Heater shall be condensing, gas fired, water heater design certified to the ANSI Z21.10.3 standard for gas fired water heaters.
- .4 Tankless Water Heater shall have a residential energy star rating.
- .5 Tankless Water Heater shall have a thermal efficiency of 97% and a Uniform Energy Factor of 0.98.
- .6 Tankless Water Heater shall utilize a direct electronic ignition system (with no standing pilot), fully modulating gas control valve, turbine flow meter, automatic electro-mechanical water flow control valve, and water temperature thermistors to maintain outlet water temperature between  $\pm 2^{\circ}\text{F}$  ( $-17^{\circ}\text{C}$  to  $-19^{\circ}\text{C}$ ) of set point temperature.
- .7 Tankless Water Heater shall incorporate the following internal safety devices: flame failure lockout, boiling protection lockout, thermal overheat protection, internal freeze protection for ambient temperatures as low as  $-22^{\circ}\text{F}$  ( $-30^{\circ}\text{C}$ ), and lockout protection in the event of a blocked flue.
- .8 Tankless Water Heater shall be provided with a temperature thermostat with an adjustable set point range of  $98^{\circ}\text{F}$  ( $37^{\circ}\text{C}$ ) to  $185^{\circ}\text{F}$  ( $85^{\circ}\text{C}$ ).
- .9 Tankless Water Heater shall have downward fired fiber mesh burners, solid brass water flow control valve, and solid brass inlet and outlet water connections.
- .10 Storage tanks shall have 2 in. (51 mm) thick uniform foam insulation. Inner tank shall be formulated with an enamel coating. Storage tank(s) shall have a test pressure of 300 PSI (21 bar) and working pressure of 150 PSI (10.3 bar). Storage tank(s) shall have 1-1/2 in. (38.1 mm) MNPT dielectric hot and cold water connections, pressure relieve valve, brass drain valve and dual magnesium anode rods.
- .11 Tankless Water Heater shall have a primary stainless steel heat exchanger and a secondary stainless steel heat exchanger
- .12 Provide with common venting and condensate neutralization kit.
- .13 Electrical: Refer to electrical drawings and Mechanical Equipment Schedules Drawing for reference.

- .14 Acceptable Product: As per schedule on Mechanical Equipment Schedules Drawing or approved equal.

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 in accordance with manufacturer's recommendations and authority having jurisdiction.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.

3.4 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION



Part 1            General

1.1            REFERENCE STANDARDS

- .1    American Society for Mechanical Engineers (ASME International)
- .2    CSA Group (CSA)
  - .1    CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
  - .2    CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code, Amendment.

1.2            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 and include product characteristics, performance criteria, physical size, finish and limitations.
- .3    Shop Drawings:
  - .1    Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2    Include plans, details, and connections to piping systems.
  - .3    Wiring Diagrams: Power, signal, and control wiring.

1.3            CLOSEOUT SUBMITTALS

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

1.4            DELIVERY, STORAGE AND HANDLING

- .1    Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2    Storage and Handling Requirements:
  - .1    Store materials off ground in dry location indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2    Store and protect energy recovery equipment from nicks, scratches, and blemishes.
  - .3    Replace defective or damaged materials with new.

1.5            EXTRA MATERIALS

- .1    Provide spare parts in accordance with Section 01 78 00 - Closeout Submittals.
- .2    Provide one spare regenerating valve.

Part 2 Products

2.1 WATER SOFTENER (WS-1)

- .1 Acceptable product: "Canature Watergroup" model 95MTS 150-1.25D8000.
- .2 Configuration: Duplex Mineral tank and Two brine tanks
- .3 Mineral Tank
  - .1 Certification must meet NSF/ANSI 44 standards for Materials and Structural Integrity.
  - .2 The tank construction shall feature a polyethylene liner and outer winding composed of high-performance fiberglass and epoxy resin. It should withstand a maximum operating pressure of 1034 kPa gauge (150 psig), operate within a temperature range of 1 °C – 49 °C (34 °F – 120 °F), and endure a maximum vacuum of 127 mm Hg (2.46 psi).
  - .3 The mineral tanks shall be accompanied by a five (5) years warranty.
- .4 Media
  - .1 The ion exchange resin must possess a total capacity of 1.9 eq/L in the sodium form. Each mineral tank should contain 142L (5 ft<sup>3</sup>) of Aquafine AQ100-Na resin, WQA certified to NSF/ANSI 44 standards, and compliant with the US FDA Code of Federal Regulations, Section 173.25.
- .5 Brine Tank
  - .1 Each softener unit shall be equipped with one (1) brine tank.
  - .2 The brine tank shall have a diameter of 610 mm (24") and a height of 940 mm (37").
  - .3 The brine tank shall include essential components such as a salt plate, removable salt lid, brine well, safety float, and brine well cap.
  - .4 The brine tank shall be covered by a one (1) year warranty.
- .6 Control Valve
  - .1 Each mineral tank must be equipped with a 32mm (1.25") top-mounted control valve, featuring a plastic PPO (Noryl) body and a motor-driven, piston/seal/spacer type mechanism. The valves come complete with an electronic slave controller, interlinked with a separate main controller through interlinking cables that deliver power to each valve.
  - .2 Operating valves must efficiently perform essential functions such as backwash, brine draw, slow rinse, rapid rinse, and brine tank refill. Additional features include an integrated turbine meter and an LCD display indicating unit address, along with two (2) programmable auxiliary output relays.
  - .3 For operational flexibility, each valve shall include a 32 mm (1.25") electronic ball valve on the outlet side and must regenerate co-currently, ensuring consistent system performance.
  - .4 Certified to NSF/ANSI 44 standards for materials and structural integrity, these valves shall be designed to operate under pressures ranging from 137 – 862 kPa gauge (20 – 125 psig) and within a temperature range of 1 °C (34 °F) to 43 °C (110 °F).
  - .5 The control valves shall be covered by a five (5) years warranty.

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 Provide certificate, signed by manufacturer, stating that pipe system has been installed in accordance with manufacturer's recommendations.
- .2 System to be completely accessible for removal, modification and cleaning.

3.3 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1            General

1.1            REFERENCES

- .1            Air-Conditioning and Refrigeration Institute (ARI)
  - .1            ARI 1010, Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.
- .2            CSA Group
  - .1            CAN/CSA-B45 Series, Plumbing Fixtures.
  - .2            CSA B125.3, Plumbing Fittings.
  - .3            CSA B651, Accessible Design for the Built Environment.
- .3            Green Seal (GS)
  - .1            GS-36, Adhesives for Commercial Use.
- .4            South Coast Air Quality Management District (SCAQMD)
  - .1            SCAQMD Rule 1168, Adhesive and Sealant Applications.

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 plumbing fixtures and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2            Indicate fixtures and trim:
    - .1            Dimensions, construction details, roughing-in dimensions.
    - .2            Factory-set water consumption per flush at recommended pressure.
    - .3            (For water closets, urinals): minimum pressure required for flushing.

1.3            CLOSEOUT SUBMITTALS

- .1            Include:
  - .1            Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
  - .2            Details of operation, servicing, maintenance.
  - .3            List of recommended spare parts.

1.4            DELIVERY, STORAGE AND HANDLING

- .1            Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2            Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3            Storage and Handling Requirements:

- .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials from damage.
  - .3 Replace defective or damaged materials with new.
- Part 2 Products
- 2.1 PLUMBING FIXTURES - GENERAL
- .1 Fixture piping:
    - .1 Hot and cold-water supplies to fixtures:
      - .1 Chrome plated rigid supply pipes with hand wheel stop, reducers, and escutcheon.
    - .2 Waste:
      - .1 Brass P trap with clean out on fixtures not having integral trap.
      - .2 Chrome plated in exposed places.
      - .3 Insulated ADA compliant for Universal Access fixtures.
  - .2 Fixture carriers:
    - .1 Factory manufactured heavy duty floor-mounted carrier systems for wall-mounted fixtures.
    - .2 Fixture carriers shall be suitable for installation with associated wall type, i.e. steel stud or CMU wall. Refer to architectural plans for associated wall types.
- 2.2 FLOOR MOUNTED WATER CLOSET (WC-1)
- .1 Water Closet:
    - .1 Floor mounted elongated bowl, Vitreous china, white finish, Flushometer valve siphon, 422 mm (16-5/8") high, operates in the range 1.1-1.6 GPF, 254 mm x 305 mm (10" x 12") water surface area, 54 mm (2-1/8") fully glazed internal trapway, Floor outlet, 38 mm (1-1/2") dia top spud.
    - .2 Acceptable product: "American Standard" model 3451001.020 or approved equal.
  - .2 Seat:
    - .1 Commercial grade, for elongated bowl, open front, white, check hinge, without cover.
    - .2 Acceptable product: "Centoco" model 500STSCCFE-001 or approved equal.
  - .3 Flush Valve:
    - .1 Exposed flushometer, for 1-1/2" top spud water closet fixture, polished chrome finish, Body mounted sensor, 1.28 GPF flow, rubber diaphragm, automatic operation, hardwired, infrared sensor, 11 1/2" rough-in, 1" inlet, Vacuum breaker.
    - .2 Acceptable product: "Sloan" model ECOS 111-1.28 or approved equal.

- .4 Provide floor flange, same material as the connecting pipe drain, with all brass bolts and with rubber gasket.
- 2.3 BARRIER FREE UNIVERSAL ACCESS WATER CLOSET (WC-2)
- .1 Water Closet:
    - .1 Floor mounted elongated bowl, Vitreous China, white finish, , 419 mm (16-1/2") rim height, operates in the range of 1.1-1.6 GPF, 254 mm x 305 mm (10" x 12") water surface area, 54 mm (2-1/8") fully glazed trapway, Floor outlet, bolt caps, 38 mm (1-1/2") dia top spud, ADA and CSA B651 complaint.
    - .2 Acceptable Product "American Standard" model 3461001.020 or approved equal.
  - .2 Seat:
    - .1 Commercial grade, for elongated bowl, open front, Antimicrobial, , check hinge, with cover.
    - .2 Acceptable Product: "Centoco" model 820STSS-001 or approved equal.
  - .3 Flush Valve:
    - .1 Exposed flushometer, for 1-1/2" top spud water closet fixture, polished chrome plated body, Body mounted sensor, 1.28 GPF flow, ADA compliant, automatic operation, hardwired, infrared sensor, 610mm (24") rough-in height, 1" inlet, Vacuum breaker, Dual flush.
    - .2 Acceptable Product: "Sloan" model ECOS 115-1.28-HW or approved equal.
  - .4 Provide floor flange, same material as the connecting pipe drain, with all brass bolts and with rubber gasket.
- 2.4 UNIVERSAL ACCESS URINAL (UR-1)
- .1 Urinal:
    - .1 Vitreous china, white finish, wall-hung, 0.125-1.0 GPF flush volume, washdown flush action, 51mm (2") outlet, 19mm (3/4") top spud connection, ADA compliant.
    - .2 Acceptable Product: "American Standard" model 6590001.020 or approved equal.
  - .2 Flush Valve:
    - .1 Automatic, no-touch operation, exposed flushometer, 0.125 GPF flow, 19mm (3/4") top spud connection, hardwired, infrared sensor, 292mm (11-1/2") rough-in height, polished chrome finish.
    - .2 Acceptable Product: "Sloan" model ECOS-186-HW-0.125 or approved equal.
  - .3 Carrier:
    - .1 Epoxy coated, floor mounted, universal steel hangar support plate, integral mounting brackets.

- .2 Acceptable Product: "Watts" model CA-321 or approved equal.
- .4 Cleanout:
  - .1 Stainless steel cover, two-piece expandable plug, line cleanout.
  - .2 Approved Product: "Watts" model WUCO or approved equal.
- 2.5 WALL-HUNG LAVATORY (LAV-1)
  - .1 Basin:
    - .1 Wall-hung lavatory, with faucet ledge, 508 mm (20") long, 464 mm (18-1/4") wide, 187 mm (7-3/8") high, with rear overflow drain, oval basin, vitreous china, white finish, single hole centerset.
    - .2 Acceptable product: "American Standard" model 9024001EC.020 or approved equal.
  - .2 Faucet:
    - .1 Counter mounted, automatic no-touch operation, hardwired, c/w box transformer, single hole centerset, 0.5 GPM maximum flowrate, infrared sensor, metal, polished chrome finish.
    - .2 Acceptable Product: "Sloan" model EFX-200 or approved equal.
  - .3 Mixing Valve:
    - .1 Thermostatic mixing control valve, nickel plated, 8 GPM maximum flowrate, 3/8" inlet.
    - .2 Acceptable Product: "Lawler" model 570 or approved equal.
  - .4 Drain:
    - .1 Open grid PO plug, cast brass straight one-piece top, chrome plated finish, 17-gauge 152 mm (6") long, 32 mm (1-1/4") diameter tailpiece.
    - .2 Acceptable product: "McGuire" 155A fixture drain or approved equal.
  - .5 Supply:
    - .1 Lead free brass body, 305mm (12") flexible copper risers, 13mm (1/2") sweat inlet, 10mm (3/8") O.D. outlet, chrome-plated finish.
    - .2 Acceptable Product: "McGuire" LFBV170 or approved equal.
  - .6 P-Trap:
    - .1 Heavy cast brass adjustable p-trap, 292 mm (11-1/2") distance, cleanout plug, steel shallow flange, neoprene gasket, slipknots, 17-gauge seamless tubular wall bend.
    - .2 Acceptable Product: "McGuire" #8872C p-trap or approved equal.
  - .7 Carrier:
    - .1 Standard application:
      - .1 Floor mounted, concealed arms, adjustable arms, epoxy coated.

- .2 Accepted Product: "Watts" model WCA-411 or approved equal.
  - .2 Back-to-back application:
    - .1 Back-to-back, floor mounted, concealed arms, adjustable arms, epoxy coated.
    - .2 Accepted Product: "Watts" model WCA-411-D or approved equal.
- 2.6 UNIVERSAL ACCESS WALL-HUNG LAVATORY (LAV-2)
  - .1 Basin:
    - .1 Wall-hung lavatory, with faucet ledge, 508 mm (20") long, 464 mm (18-1/4") wide, 187 mm (7-3/8") high, with rear overflow drain, oval basin, vitreous china, white finish, single hole centerset, ADA compliant.
    - .2 Acceptable product: "American Standard" model 9024001EC.020 or approved equal.
  - .2 Faucet:
    - .1 Counter mounted, automatic no-touch operation, hardwired, c/w box transformer, single hole centerset, 0.5 GPM maximum flowrate, infrared sensor, metal, polished chrome finish, ADA compliant.
    - .2 Acceptable Product: "Sloan" model EFX-200 or approved equal.
  - .3 Mixing Valve:
    - .1 Thermostatic mixing control valve, nickel plated, 8 GPM maximum flowrate, 3/8" inlet.
    - .2 Acceptable Product: "Lawler" model 570 or approved equal.
  - .4 Drain:
    - .1 Open grid PO plug, cast brass straight one-piece top, chrome plated finish, 17-gauge 152 mm (6") long, 32 mm (1-1/4") diameter tailpiece, ADA compliant.
    - .2 Acceptable product: "McGuire" #155A fixture drain or approved equal.
  - .5 Supply:
    - .1 Lead free brass body, 305mm (12") flexible copper risers, 13mm (1/2") sweat inlet, 10mm (3/8") O.D. outlet, chrome-plated finish, ADA compliant.
    - .2 Acceptable Product: "McGuire" LFBV170 or approved equal.
  - .6 P-Trap:
    - .1 Glossy white, anti-microbial, wrapped cast brass, ADA compliant.
    - .2 Acceptable Product: "McGuire" PW2125WC or approved equal.
  - .7 Carrier:
    - .1 Floor mounted, concealed arms, adjustable arms, epoxy coated.
    - .2 Accepted Product: "Watts" model WCA-411 or approved equal.



2.7 BARRIER FREE WALL-HUNG LAVATORY (LAV-3)

.1 Basin:

- .1 Wall-hung lavatory, stainless steel, single hole centerset, coved bowl, 95mm (3-3/4") high backsplash, center back waste location. Overall dimensions: 419 mm (16-1/2") long, 432 mm (17") wide, 248 mm (9-3/4") high, ADA compliant.
- .2 Acceptable product: "Franke Commercial" model WHB1617-316-3-1 or approved equal.

.2 Faucet:

- .1 Counter mounted, automatic no-touch operation, hardwired, c/w box transformer, single hole centerset, 0.5 GPM maximum flowrate, infrared sensor, metal, polished chrome finish, ADA compliant.
- .2 Acceptable Product: "Sloan" model EFX-200 or approved equal.

.3 Mixing Valve:

- .1 Thermostatic mixing control valve, nickel plated, 8 GPM maximum flowrate, 3/8" inlet.
- .2 Acceptable Product: "Lawler" model 570 or approved equal.

.4 Drain:

- .1 Open grid PO plug, cast brass straight one-piece top, chrome plated finish, 17-gauge 152 mm (6") long, 32 mm (1-1/4") diameter tailpiece, ADA compliant.
- .2 Acceptable product: "McGuire" #155A fixture drain or approved equal.

.5 Supply:

- .1 Lead free brass body, 305mm (12") flexible copper risers, 13mm (1/2") sweat inlet, 10mm (3/8") O.D. outlet, chrome-plated finish, ADA compliant.
- .2 Acceptable Product: "McGuire" LFBV170 or approved equal.

.6 P-Trap:

- .1 Glossy white, anti-microbial, wrapped cast brass, ADA compliant.
- .2 Acceptable Product: "McGuire" PW2125WC or approved equal.

.7 Carrier:

- .1 Epoxy coated, concealed arms, adjustable wall plate and bracket, ADA compliant.
- .2 Acceptable Product: "Watts" model CA-462 or approved equal.

2.8 SHOWER (SH-1)

.1 Shower valve:

- .1 Push button electronic shower system, Hardwire – 24 VAC to 6 VDC, Stainless steel cover with S/S vandal resistant mounting screws, Metal mounting box, Field adjustable shower time, Slow closing solenoid valve, Integral stop

- .2 Showerhead:
    - .1 30° Vandal Resistant, Cast Wall Mount Showerhead, MAX: 1.5 GPM @ 80 PSI (5.7 L/min @ 552 kPa), MIN: 1.38 GPM @ 45 PSI (5.22 L/min @ 310 kPa)
  - .3 Acceptable Product: "Delta" model 860T167 or approved equal.
- 2.9 UNIVERSAL ACCESS SHOWER (SH-2)
- .1 Shower valve:
    - .1 ADA compliant, Push button electronic shower system, Hardwire – 24 VAC to 6 VDC, Stainless steel cover with S/S vandal resistant mounting screws, Metal mounting box, Field adjustable shower time, Slow closing solenoid valve, Integral stop
  - .2 Hand Shower:
    - .1 ADA compliant, Hand shower with Push Button Pause and standard 24" (610mm) Stainless Steel Slide Bar, MAX: 1.5 GPM @ 80 PSI (5.7 L/min @ 552 kPa), MIN: 1.38 GPM @ 45 PSI (5.22 L/min @ 310 kPa)
  - .3 Acceptable Product: "Delta" model 860T157 or approved equal.
- 2.10 TRIPLE BOWL SINK (SK-1)
- .1 Basin:
    - .1 Triple compartment sink, 203mm (8") centerset, stainless steel, with backsplash, with drainboard, stainless steel adjustable legs, center waste location, satin finish. Overall dimensions: 1457mm (57-3/8") long, 691mm (27-3/16") wide, 1118mm (44") height.
    - .2 Acceptable Product: "Franke Commercial" model TL-2454-1 CL-DB Sink or approved equal.
  - .2 Faucet:
    - .1 Wall mounted, lever handles, 2.2 GPM nozzle flowrate, 1.07 GPM spray valve w/ swivel, 1/2" NPT male inlets, adjustable wall bracket, polished chrome finish.
    - .2 Acceptable Product: "T&S" model B-0133-14CRQJST or approved equal.
  - .3 P-Trap:
    - .1 Heavy cast brass adjustable p-trap, 292 mm (11-1/2") distance, cleanout plug, steel shallow flange, neoprene gasket, slipknots, 17-gauge seamless tubular brass bend.
    - .2 Acceptable Product: "McGuire" 8912C or approved equal.
- 2.11 HAND WASH SINK (SK-2)
- .1 Basin and Faucet:
    - .1 Basin:

- .1 Stainless steel, wall mounted. Overall Dimensions: 438mm (17 ¼") L x 387mm (15 ¼") W x 253mm (10") H.
    - .2 Faucet:
      - .1 4" wall mounted faucet, lever handles, 2.2 GPM flowrate.
    - .3 Acceptable Product: "T&S" model B-1146-02A-4W or approved equal.
  - .2 P-Trap:
    - .1 Heavy cast brass adjustable p-trap, 292 mm (11-1/2") distance, cleanout plug, steel shallow flange, neoprene gasket, slipknots, 17-gauge seamless tubular brass bend.
    - .2 Acceptable Product: "McGuire" 8912C or approved equal.
- 2.12 COUNTER MOUNT SINK (SK-3)
  - .1 Basin:
    - .1 Single compartment, 203mm (8" centerset), stainless steel, center back waste location, satin finish. Overall dimensions: 562mm (22-1/8") long, 478mm (18-13/16") wide, 254mm (10") height.
    - .2 Acceptable Product: "Franke Commercial" model LBS4010P-1/3 or approved equal.
  - .2 Faucet:
    - .1 Counter mounted, manual, two handles, 8" gooseneck spout, 203mm (8") centerset, solid brass, 1.5GPM maximum flowrate, 13mm (1/2") inlet, polished chrome finish.
    - .2 Accepted Product: "American Standard" model 6409170.002 or approved equal.
  - .3 Supply:
    - .1 Lead free brass body, 305mm (12") flexible copper risers, 13mm (1/2") sweat inlet, 10mm (3/8") O.D. outlet, chrome-plated finish.
    - .2 Acceptable Product: "McGuire" LFBV170 or approved equal.
  - .4 P-Trap:
    - .1 Heavy cast brass adjustable p-trap, 292 mm (11-1/2") distance, cleanout plug, steel shallow flange, neoprene gasket, slipknots, 17-gauge seamless tubular brass bend.
    - .2 Acceptable product: "McGuire" 8912C or approved equal.
- 2.13 JANITOR SINK (JS-1)
  - .1 Basin:
    - .1 Single compartment, floor mounted, molded stone, with service faucet, with hose & hose bracket, with mop hanger, 75mm (3") drain pipe, , white finish.

Overall dimensions: 610mm (24") long, 610mm (24") wide, 254mm (10") height.  
Include hose, hose bracket, mop hanger.

- .2 Service Faucet:
    - .1 Chrome-plated faucet with vacuum breaker, pail hook, 19mm (3/4") hose thread on spout. Include hose and hose bracket.
  - .3 Acceptable Product: "Fiat" model MSB2424 with options 830AA, 832AA, and 889CC, or approved equal.
- 2.14 WALL MOUNTED DRINKING FOUNTAIN & BOTTLE FILLING STATION (DF-1)
- .1 Drinking Fountain:
    - .1 Wall mounted, c/w bottle filler, hands free sensor or push button operation, 1 GPM fill rate, 120VAC/9.0VDC plug-in transformer, gray finish for cooler, satin finish for bottle filler.
    - .2 Acceptable Product: "Murdock" model A171108F-UG-BF12 or approved equal.
  - .2 Stop Valves:
    - .1 Lead free, 3/8" I.P.S. x 3/8" O.D., chrome-plated finish.
    - .2 Acceptable Product: "McGuire" model LFHST01 or approved equal.
  - .3 P-Trap:
    - .1 Heavy cast brass, chrome-plated finish.
    - .2 Acceptable Product: "McGuire" model 8872C or approved equal.
  - .4 Carrier:
    - .1 Epoxy coated, floor mounted, universal steel hangar support plate, integral mounting brackets.
    - .2 Acceptable Product: "Watts" model CA-321 or approved equal.
- 2.15 FLOOR DRAIN (FD-1)
- .1 Epoxy coated cast iron, adjustable round 6mm (1/4") thick top, trap primer tapping, reversible membrane clamp, with strainer.
  - .2 Acceptable product: "Watts" model FD-100-C-A or approved equal.
- 2.16 FUNNEL FLOOR DRAIN (FFD-1)
- .1 Epoxy coated cast iron, adjustable, reversible membrane clamp, trap primer tapping 102mm x 229mm (4" x 9") elongated oval nickel bronze funnel.
  - .2 Acceptable product: "Watts" model FD-100-EG or approved equal.
- 2.17 NON-FREEZE HOSE BIBB (HB-1)
- 2.18 CONCEALED NON-FREEZE KEY OPERATED WALL HYDRANT WITH NICKEL BRONZE BOX AND DOOR, STANDARD BOX, CHROME PLATED HYDRANT FACE, INTEGRAL VACUUM

BREAKER, 3/4"(19) HOSE CONNECTION, 3/4"(19) FEMALE X 1"(25) MALE PIPE CONNECTION, ALL BRONZE HEAD, SEAT CAST-ING AND INTERNAL WORKING PARTS, BRONZE WALL CASING, AND LOOSE KEY. COMPLIES WITH ASME B1.20.7 AND ASSE 1019-2004. UPC/IAMPO LISTED. MAX. OPERATING PRESSURE 125 PSI..

- .1 Acceptable product: "Watts" model HY-725 or approved equal.

### 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 washroom fixtures 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 the Contract Administrator.

#### 3.2 INSTALLATION

- .1 Mounting heights:
  - .1 Standard: to manufacturer's recommendations, measured from finished floor.
  - .2 Wall-hung fixtures: measured from finished floor.
  - .3 Barrier-free: to most stringent requirements.

#### 3.3 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
  - .1 Adjust water flow rate to design flow rates.
  - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
  - .3 Adjust flush valves to suit actual site conditions.
  - .4 Adjust urinal flush timing mechanisms.
  - .5 Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.
- .3 Checks:
  - .1 Water closets, urinals: flushing action.
  - .2 Aerators: operation, cleanliness.
  - .3 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:

.1 Verify temperature settings, operation of control, limit, and safety controls.

3.4 CLEANING

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1	General
1.1	SUMMARY
.1	Section Includes:
.1	Use of mechanical systems during construction.
1.2	USE OF SYSTEMS
.1	Use of new or existing permanent HVAC systems for supplying temporary heating, cooling or ventilation is not permitted.
Part 2	Products
2.1	NOT USED
.1	Not Used.
Part 3	Execution
3.1	GENERAL
.1	Seal open ends of installed ductwork to prevent entry of dirt and debris during construction.

END OF SECTION

**Part 1** General

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .2 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-11, Environmental Standard for Paints and Coatings.
- .3 National Fire Code of Canada (NFCC 2005)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish, and limitations.

**1.3** DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

**Part 2** Products

2.1 MATERIAL

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
  - .1 Primers, paints, and coating: in accordance with manufacturer's recommendations for surface conditions.
- .2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
- .3 Fire Stopping: in accordance with Section 07 84 00 - Firestopping.

**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 without interrupting operation of other system, equipment, or components.

### 3.4 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain.
  - .1 Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap, and chain.

### 3.5 AIR VENTS

- .1 Install automatic air vents at high points in the piping.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

### 3.6 DIELECTRIC COUPLINGS

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: isolating flanges.

### 3.7 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.

- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 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.
- .6 Install exposed piping, equipment, rectangular cleanouts, and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated.
- .14 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.
  - .6 Use ball or butterfly valves at branch take-offs for isolating purposes except where specified.
  - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
  - .8 Install ball valves for glycol service.
- .15 Check Valves:
  - .1 Install silent check valves where indicated on plans.

### 3.8 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.

- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
  - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
  - .2 Other floors: terminate 25 mm (1") 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.

### 3.9 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one piece type with set screws.
  - .1 Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: outside diameter to cover opening or sleeve.
  - .1 Inside diameter to fit around pipe or outside of insulation if so provided.

### 3.10 PREPARATION FOR FIRE STOPPING

- .1 Install firestopping within annular space between pipes, ducts, insulation, and adjacent fire separation in accordance with Section 07 84 00 - Firestopping.
- .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 firestopping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

- .1 Flush system in accordance with Section 23 08 02 - Cleaning and Start-Up of HVAC Piping Systems.
- .2 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.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Contract Administrator 48 hours minimum prior to performance of pressure tests.
- .2 Pework: 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 Pay costs for repairs or replacement, retesting, and making good. Contract Administrator to determine whether repair or replacement is appropriate.
- .6 Insulate or conceal work only after approval and certification of tests.

3.13 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

**Part 1** General

**1.1** SUMMARY

- .1 Section Includes:
  - .1 Electrical motors, drives and guards for mechanical equipment and systems.
  - .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
  - .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.
  - .4 Sustainable requirements for construction and verification.

**1.2** REFERENCE STANDARDS

- .1 American Society Heating Refrigeration Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Canadian Federal Legislation and Guidelines
  - .1 CEAA, Canadian Environmental Assessment Act.
  - .2 CEPA, Canadian Environmental Protection Act.
  - .3 TDGA, Transportation of Dangerous Goods Act.
- .3 Electrical Equipment Manufacturers Association Council (EEMAC)
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).

**1.3** ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit copies of WHMIS SDS in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Quality Control:
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.

- .4 Closeout Submittals:
  - .1 Provide maintenance data for motors, drives, and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- 1.4 QUALITY ASSURANCE**
  - .1 Regulatory Requirements: work to be performed in compliance with CEAA, CEPA, TDGA, and applicable Provincial regulations.
  - .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 41 00 - Regulatory Requirements.
- 1.5 DELIVERY, STORAGE, AND HANDLING**
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
  - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- 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 0.37 kW (1/2 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120V, unless otherwise specified or indicated.
  - .3 Motors 0.37 kW (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, 600V, unless otherwise specified or indicated.
  - .4 Electronically Commutated Motors:
    - .1 Motor enclosures: Open type
    - .2 Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications.
    - .3 Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
    - .4 Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
    - .5 Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
    - .6 Motor shall be a minimum of 85% efficient at all speeds.

## **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 RPM.
- .4 For motors 7.5 kW (10 HP) and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

## **2.5** DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives:
  - .1 Expanded metal screen welded to steel frame.
  - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
  - .3 38mm diameter 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 (3/4") mesh.
  - .2 Net free area of guard: not less than 80% of fan openings.

- .3 Securely fasten in place.
- .4 Removable for servicing.

**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 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 Verification requirements include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Certified wood.
  - .8 Low-emitting materials.

**3.4** CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION



Part 1 General

1.1 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.

1.2 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 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 Ranges: 0-1100 kPa (0-160 psig).

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, liquid filled, 125 mm (5") 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

- .1 112 mm (4-1/2"), dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.
- .2 Provide:
  - .1 Snubber for pulsating operation.
  - .2 Diaphragm assembly for corrosive service.
  - .3 Gasketed 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 Hydronic Pumps.
  - .4 Hot Water Tanks.
  - .5 In other locations as indicated on the Mechanical Drawings.
- .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 on the Mechanical Drawings.
- .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 lamacoid nameplates in accordance with Section 23 05 53.01 - Mechanical Identification, Identifying medium.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
  - .1 Submit shop drawings for:
    - .1 Bases, hangers and supports.
    - .2 Connections to equipment and structure.
    - .3 Structural assemblies.
- .4 Manufacturers' Instructions:
  - .1 Provide manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

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

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 B31.1 or MSS SP58.
- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58.

2.3 PIPE HANGERS

.1 Finishes:

- .1 Pipe hangers and supports: galvanized after manufacture.
- .2 Use hot dipped galvanizing process.
- .3 Ensure steel hangers do not come in contact with copper piping.

.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.
  - .1 Rod: 9 mm UL listed.
- .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed.

.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.
- .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.
- .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 rivetting to insulation shields.
- .8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .9 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: epoxy 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: galvanized 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 64 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 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

## 2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

## 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 Manitoba Plumbing Code.
- .2 Fire protection: to applicable fire code.
- .3 Gas piping: in accordance with relevant CSA codes.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .6 Within 300 mm of each elbow.

### 3.4

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

- .1 Pipework greater than NPS 12: to MSS SP69.

### 3.5 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.

3.6 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.

3.7 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.

3.8 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in Part 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting, and cleaning of product and submit Manufacturer's Field Reports as described in Part 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in Part 1 - QUALITY ASSURANCE.

3.9 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION



**Part 1** General

**1.1** REFERENCES

- .1 Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .2 National Research Council Canada (NRC)
  - .1 National Building Code of Canada (NBC).

**1.2** ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit manufacturer's printed product literature, specifications, and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

**1.3** DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Dispose of waste materials in accordance with Section 01 74 21 - Construction Waste Management.

**Part 2** Products

**2.1** GENERAL

- .1 Size and shape of bases type and performance of vibration isolation as indicated.

**2.2** ELASTOMERIC PADS

- .1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.
- .2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
- .3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
- .4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

**2.3 ELASTOMERIC MOUNTS**

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

**2.4 SPRINGS**

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Cadmium plate for outdoor and 100% relative humidity installations.
- .4 Colour code springs.

**2.5 SPRING MOUNT**

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.
- .6 Performance: as indicated.

**2.6 HANGERS**

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal-to-metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with pre-compression washer and nut with deflection indicator.
- .6 Performance: as indicated.

**2.7** ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy-duty duck and neoprene isolation material.

**2.8** HORIZONTAL THRUST RESTRAINT

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

**2.9** STRUCTURAL BASES

- .1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
- .2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.
- .3 Bases to clear housekeeping pads by 25 mm minimum.

**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 vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.
- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
  - .1 Up to NPS4: first 3 points of support.
  - .2 NPS 5 to NPS 8: first 4 points of support.
  - .3 NPS 10 and over: first 6 points of support.

- .4 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
  - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
    - .1 After delivery and storage of Products.
    - .2 After preparatory work is complete but before installation commences.
    - .3 Twice during the installation, at 25% and 60% completion stages.
    - .4 Upon completion of installation.
  - .3 Submit manufacturer's reports to Contract Administrator within 3 days of manufacturer representative's review.
  - .4 Make adjustments and corrections in accordance with written report.
- .2 Inspection and Certification:
  - .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start-up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .2 Take vibration measurements for equipment.
  - .3 Provide Contract Administrator with notice twenty-four (24) hours in advance of commencement of tests.
  - .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
  - .5 Submit complete report of test results.

### **3.4 CLEANING**

- .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

**Part 1** General

**1.1** SUMMARY

.1 Section Includes:

- .1 Materials and requirements for the identification of piping systems, duct work, valves, and controllers, including the installation and location of identification systems.

**1.2** REFERENCES

.1 Canadian Gas Association (CGA)

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

.2 Canadian General Standards Board (CGSB)

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

.3 National Fire Protection Association (NFPA)

- .1 NFPA 13, Standard for the Installation of Sprinkler Systems.

**1.3** ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data.

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

.3 Product data to include paint colour chips, other products specified in this section.

.4 Samples:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples to include nameplates, labels, tags, lists of proposed legends.

**1.4** QUALITY ASSURANCE

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

.2 Health and Safety:

- .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health & Safety Requirements.

**1.5** DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling, and unloading:

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

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 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.

## 2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
  - .1 Natural gas: to CSA/CGA B149.1.
  - .2 Sprinklers: to NFPA 13.

## 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:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE
  - .3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
City water	Green	CITY WATER
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Make-up water	Yellow	MAKE-UP WTR
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Gas regulator vents	to Codes	
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

## 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 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 TIMING

- .1 Provide identification only after painting specified Section 09 91 00 - Painting has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 NAMEPLATES

- .1 Locations:
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
  - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
  - .1 Do not paint, insulate, or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping, or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Contract Administrator. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 CLEANING

- .1 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.
- .3 This section includes the testing of all new fire dampers.

**1.2** QUALIFICATIONS OF TAB PERSONNEL

- .1 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.
  - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
  - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.
- .2 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .3 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .4 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .5 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .6 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
  - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
  - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

**1.3** PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.
- 1.4 EXCEPTIONS
  - .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.
- 1.5 CO-ORDINATION
  - .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
  - .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.
- 1.6 PRE-TAB REVIEW
  - .1 Review contract documents before project construction is started and confirm in writing to 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.
- 1.7 EXISTING SYSTEM PRE-RECORD TAB
  - .1 Pre-record existing building heat pump loop flow rates prior to demolition of system to return existing system to original operation after completion of construction.
- 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 seven (7) days prior to start of TAB.
  - .2 Start TAB when building is essentially completed, including:
  - .3 Installation of ceilings, doors, windows, other construction affecting TAB.
  - .4 Application of weatherstripping, sealing, and caulking.
  - .5 Pressure, leakage, other tests specified elsewhere Division 23.
  - .6 Provisions for TAB installed and operational.

- .7 Start-up, verification for proper, normal, and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
  - .1 Proper thermal overload protection in place for electrical equipment.
  - .2 Air systems:
    - .1 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 10 %, minus 5 %.
    - .2 Hydronic systems: plus or minus 5%.
    - .3 Domestic Hot Water Recirculation System: plus or minus 5%.
- 1.12 ACCURACY TOLERANCES
  - .1 Measured values accurate to within plus or minus 2 % of actual values.
- 1.13 INSTRUMENTS
  - .1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
  - .2 Calibrate within three (3) months of TAB.
- 1.14 ACTION AND INFORMATIONAL SUBMITTALS
  - .1 Submit, prior to commencement of TAB:
  - .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

- 1.15 TAB REPORT
  - .1 Format in accordance with relevant standard.
  - .2 TAB report to show results in SI units and to include:
    - .1 Project record drawings.
    - .2 System schematics.
  - .3 Submit 1 copy of TAB Report to Contract Administrator for verification and approval, in English in D-ring binders, complete with index tabs.
- 1.16 VERIFICATION
  - .1 Reported results subject to verification by Contract Administrator
  - .2 Provide personnel and instrumentation to verify up to 30 % of reported results.
  - .3 Pay costs to repeat TAB as required to satisfaction of Contract Administrator.
- 1.17 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.
- 1.18 COMPLETION OF TAB
  - .1 TAB considered complete when final TAB Report received and approved by the Contract Administrator.
- 1.19 AIR SYSTEMS
  - .1 Standard: TAB to most stringent of TAB standards of AABC or ASHRAE.
  - .2 Do TAB of following systems, equipment, components, controls:
    - .1 ERV-1.
      - .1 Air balancing of ERV-1 shall be performed on the high speed setting. Refer to Section 23 09 33.
    - .2 AHU-1,2,3,4,5
    - .3 MUA-1 and associated kitchen exhaust fan EF-1.
    - .4 Exhaust fans EF-2 and EF-3.
    - .5 All supply, exhaust and return grilles.
  - .3 Test all combination fire/smoke dampers.
  - .4 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.
  - .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop

(or loss), temperatures (dry bulb, wet bulb, dew point), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.6 Locations of equipment measurements: to include, but not be limited to, following as appropriate:

.1 Inlet and outlet of dampers, grille, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.7 Locations of systems measurements to include, but not be limited to, following as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

## 1.20 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 Zone pressure differences:

.1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with systems in every possible combination of normal operating modes.

## 1.21 WATER SYSTEMS

.1 Do TAB on all hydronic systems including:

Flow balance of:

.1 Main Loop Hydronic Circulation Pumps (PU-1,2).

.2 Boiler Pumps (PU-3,4,5).

.3 In-Floor Heating Manifold Pumps (PU-6,7,8,9,10).

.4 Domestic hot water recirculation pump (RP-1).

.2 Set water flows as noted. Obtain pump operating pressures, motor amperages and characteristics.

.3 Measure domestic water recirculation flow rates at all automatic flow balancing valves and record flows in balance report.

## 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 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, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

- .1 ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
- .2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
- .3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C547, Standard Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .9 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

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

.4 Green Seal Environmental Standards (GSES)

- .1 Standard GS-36, Commercial Adhesives.
  - .5 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
  - .6 Underwriters Laboratories of Canada (ULC)
    - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
    - .2 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- 1.2 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, cleaning procedures.
- 1.3 QUALITY ASSURANCE
  - .1 Qualifications:
    - .1 Installer: specialist in performing work of this section and have at least three (3) years successful experience in this size and type of project.
- 1.4 DELIVERY, STORAGE AND HANDLING
  - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Deliver materials to site in original factory packaging, labelled with 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 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 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 FSK jacket factory applied to insulation.
- .2 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire-retardant lagging adhesive to ASTM C921.
- .3 Lagging adhesive: compatible with insulation.

## 2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .2 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .3 Contact adhesive: quick-setting.
- .4 Canvas adhesive: washable.
- .5 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .6 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

## 2.5 ACOUSTIC INSULATION

- .1 Provide acoustic duct insulation for all exposed supply ductwork in occupied spaces.
- .2 Provide acoustic duct insulation for all return ductwork and transfer elbows.
- .3 25 mm (1") thick fiberglass, Knauff Plenum Liner.

## 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 manufacturer's 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 THERMAL INSULATION SCHEDULE

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

Duct System	Minimum Thermal Resistance (RSI)	Insulation Type	Location of Insulation	Unit Thermal Resistance (RSI/25mm)	Insulation Thickness (mm)	Total Thermal Resistance (RSI)
<u>Indoor Ductwork</u>						
<i>Temperature Difference = 5 to 22°C</i>						
Supply Air - Headers and Plenums – Rectangular	0.58	C-1/C-3	Exterior	0.67	25	0.67
Supply Air - Headers and Plenums – Round	0.58	C-3/C-5				
Supply Air – Runouts – Rectangular	0.58	C-1/C-3	Exterior	0.67	25	0.67
Supply Air – Runouts - Round	0.58	C-3/C-5	Exterior	0.67	25	0.67
Return Air - Headers and Plenums - Rectangular	0	N/A			-	
Return Air - Headers and Plenums - Rectangular	0	N/A			-	
Return Air – Runouts - Rectangular	0	N/A			-	

Return Air – Runouts - Round	0	N/A			-	
Outdoor/Combustion Air - Indoor Headers and Plenums - Rectangular	0.58	C-2/C-4	Exterior	0.67	25	0.67
Outdoor/Combustion Air - Indoor Headers and Plenums - Round	0.58	C-4/C-6	0.67	25	0.67	0.58
Exhaust/Relief Air - Indoor Headers and Plenums - Rectangular	0	N/A			-	
Exhaust/Relief Air - Indoor Headers and Plenums - Round	0	N/A			-	
Temperature Difference = Over 22°C						
Outdoor Air Intake - Rectangular	0.88	C-2/C-4	Exterior	0.67	50	1.34
Outdoor Air Intake - Round	0.88	C-4/C-6	Exterior	0.67	50	1.34

Notes:

- 1) Ductwork carrying conditioned air and installed outdoors needs to be insulated to same level as building wall.
- 2) Runouts are ducts that do not exceed 3 meters in length and connects to terminal grilles or diffusers.
- 3) Insulate all exhaust/relief ducts 1800 mm back from outside wall.

.2 Finishes:

- .1 All exposed round/spiral, insulated ductwork shall be finished with a PVC jacket.
- .2 All exposed rectangular, insulated ductwork shall be finished with a canvas jacket.
- .3 All concealed, insulated ductwork shall have standard foil face finish.

END OF SECTION

**Part 1** General

1.1 SUMMARY

- .1 Section Includes:
  - .1 Thermal insulation for piping and piping accessories in commercial type applications.
  - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .2 ASTM C547, Mineral Fiber Pipe Insulation.
  - .3 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2 CAN/CGSB-51.53, Poly (Vinyl Chloride) 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.
- .7 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings

- .4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

### 1.3 DEFINITIONS

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC:
  - .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 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.

### 1.5 QUALITY ASSURANCE

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

## 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°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 A-4: flexible closed-cell tubular elastomer.
  - .1 Insulation: to ASTM C534.
  - .2 Maximum "k" factor: to ASTM C534
  - .3 Certified by manufacturer: free of potential stress corrosion cracking corrodants.
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
  - .1 Insulation: with vapour retarder jacket.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

## **2.3 INSULATION SECUREMENT**

- .1 Tape: self-adhesive, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.

## **2.4 VAPOUR RETARDER LAP ADHESIVE**

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

## **2.5 INDOOR VAPOUR RETARDER FINISH**

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



2.6 OUTDOOR VAPOUR RETARDER FINISH

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

2.7 JACKETS

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
  - .2 Colours: Confirm with Contract Administrator.
  - .3 Minimum service temperatures: -5°F (-20°C).
  - .4 Maximum service temperature: 150°F (65°C).
  - .5 Moisture vapour transmission: 0.02 perm.
  - .6 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.
  - .7 Special requirements:
    - .1 Outdoor: UV rated material at least 0.5 mm thick.
- .2 Aluminum (Outdoors):
  - .1 To ASTM B209.
  - .2 Thickness: 0.5 mm sheet.
  - .3 Finish: Stucco
  - .4 Joining: Longitudinal and circumferential slip joints with 50mm laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: Stainless steel, 19 mm wide, 0.5 mm thick and 300 mm spacing.

**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 manufacturer’s 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 valves, primary flow measuring elements and flanges. Do not insulate unions at equipment on hot piping. Cold piping systems shall have no un-insulated sections.

.2

Design: to permit periodic removal and replacement without damage to adjacent insulation.

.3

Insulation:

.1

Insulation, fastenings and finishes: same as system.

.2

Jacket: PVC.

3.5

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.

Type of System	Design Operating Temperature Range (°C)	Thermal Conductivity of Insulation		Nominal Pipe Diameter				
		Conductivity Range W/m·°C)	Mean Rating Temperature (°C)	Runouts ≤ 50	≤ 25	32 to 50	63 to 100	≥ 125
				Minimum Thickness of Piping Insulation				
Heating Systems (hot water, glycol, steam,	> 177	0.046 - 0.049	121	38	63	63	75	88
	122 - 177	0.042 - 0.045	93	38	50	63	63	88

steam condensate, etc.)	94 - 121	0.039 - 0.043	65	25	38	38	50	50
	61 - 93	0.036 - 0.042	52	25	25	25	38	38
	46 - 60	0.035 - 0.040	38	25	25	25	25	38
	< 5	0.033 - 0.039	24	25	25	38	38	38
Cooling Systems (Refrigerant)	5-13	0.033 - 0.039	24	25	25	25	25	25
	< 5	0.033 - 0.039	24	25	25	38	38	38
Domestic Water Systems								
Conditioned Space								
Cold Water	-	0.035 - 0.040	38	25	25	25	38	38
Hot Water	-	0.035 - 0.040	38	25	25	25	38	38
Tempered Water	-	0.035 - 0.040	38	25	25	25	38	38
Hot Water Recirculation	-	0.035 - 0.040	38	25	25	25	38	38
Tempered Water Recirculation	-	0.035 - 0.040	38	25	25	25	38	38
Un-Conditioned Space								
Sanitary Sewer	-	0.046 - 0.049	38	38	63	63	75	88

- .3 Finishes:
- .1 Exposed in mechanical rooms and janitors room: PVC jacket.
  - .2 Exposed in occupied spaces: PVC jacket, painted.
  - .3 Concealed, indoors: PVC on valves, fittings. No further finish.
  - .4 Exposed, outdoors: Aluminum jacket with UV protection.

### 3.7 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 REFERENCES

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

- .1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

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.

Part 2 Products

2.1 CLEANING SOLUTIONS

- .1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.  
.2 Sodium carbonate: 0.40 kg per 100 L water in system.  
.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

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 Timing: systems operational, hydrostatically tested and with safety devices functional before cleaning is carried out.  
.2 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.  
.3 Cleaning procedures:  
.1 Provide detailed report outlining proposed cleaning procedures at least four (4) weeks prior to proposed starting date. Report to include:

- .1 Cleaning procedures, flow rates, elapsed time.
  - .2 Chemicals and concentrations used.
  - .3 Inhibitors and concentrations.
  - .4 Specific requirements for completion of work.
  - .5 Special precautions for protecting piping system materials and components.
  - .6 Complete analysis of water used to ensure water will not damage systems or equipment.
- .4 Conditions at time of cleaning of systems:
  - .1 Systems: free from construction debris, dirt, and other foreign material.
  - .2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
  - .3 Strainers: clean prior to initial fill.
  - .4 Install temporary filters on pumps not equipped with permanent filters.
  - .5 Install pressure gauges on strainers to detect plugging.
- .5 Report on Completion of Cleaning:
  - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .6 Hydronic Systems:
  - .1 Fill system with water, ensure air is vented from system.
  - .2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
  - .3 Use water meter to record volume of water in system to +/- 0.5%.
  - .4 Add chemicals under direct supervision of chemical treatment supplier.
  - .5 Closed loop systems: circulate system cleaner at 60°C for at least thirty-six (36) hours. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
  - .6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
  - .7 Add chemical solution to system.
  - .8 Establish circulation, raise temperature slowly to maximum design. Circulate for twelve (12) hours, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38°C. Drain as quickly as possible. Refill with clean water. Circulate for six (6) hours at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

### 3.3 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:

- .1 Establish circulation and expansion tank level, set pressure controls.
- .2 Ensure air is removed.
- .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
- .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
- .5 Clean out strainers repeatedly until system is clean.
- .6 Commission water treatment systems.
- .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
- .8 Repeat with water at design temperature.
- .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
- .10 Bring system up to design temperature and pressure slowly over a forty-eight (48) hour period.
- .11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .12 Adjust pipe supports, hangers, springs as necessary.
- .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .14 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
- .15 Check operation of drain valves.
- .16 Adjust valve stem packings as systems settle down.
- .17 Fully open balancing valves (except those that are factory-set).
- .18 Check operation of over-temperature protection devices on circulating pumps.
- .19 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

END OF SECTION

**Part 1 General**

**1.1 GENERAL**

- .1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.
- .2 Wherever words "shall be capable of" appear in specifications, interpret as meaning that; where feature or performance referred to is being applied, that feature, or performance shall be provided. Where feature or performance is not applied now, but will be applied in future, system shall be provided with all necessary central hardware and software required to support that feature or performance, with only addition of field hardware being required at that future time.
- .3 Controls contractor shall have minimum five (5) years experience in related Work.
- .4 Technical assessment of proposed system will be made as part of our selection criteria.
- .5 Controls contractor provides actuators for all motorized dampers in accordance with this section.

**1.2 SCOPE OF SERVICE**

- .1 The contractor shall provide the necessary engineering, installation, supervision, equipment, commissioning, and programming for a complete and fully operational system including but not limited to:
  - .1 Provide control shop drawings.
  - .2 Provide all wells, sensors, interface devices, automatic control valves, VAV controllers, control dampers, transducers, relays, dampers, damper actuators, wiring, conduit raceways and piping (unless otherwise noted).
  - .3 Provide graphics software, system software, and any third-party software required to meet the intent of these specifications (where required).
  - .4 Provide labelling of the controls system.
  - .5 Provide labour and supervision for installation, calibration, checkouts, and commissioning of systems.
  - .6 Provide all application, database and graphic programming (where required).
  - .7 Provide shop drawings, training manuals and as-built drawings.
  - .8 Provide operator training. 8 hrs of training required (or 2 x 4 hr sessions).
  - .9 Provide a one-year warranty on all components.
  - .10 Provide one year of maintenance.

**1.3 SCOPE OF WORK**

- .1 Includes the design, supply, installation, commissioning, and training for complete control systems for control and/or monitoring of the following equipment.
  - .1 Energy Recovery Ventilator (ERV-1), including integral motorized dampers, preheat coil, and post heat coil.

- .2 Air Handling Units (AHU-1,2,3,4,5) complete with associated Condensing Units (CU-1,2,3,4,5)
- .3 Make Up Air Unit (MUA-1) complete with associated Range Hood (RHD-1) and Kitchen Exhaust Fan (EF-1).
- .4 Wall Mounted Heat Pump (HP-1) complete with associated Condensate Pump (CP-1)
- .5 Main Loop Hydronic Circulation Pumps (PU-1,2)
- .6 Boilers (B-1,2,3) complete with associated Pumps (PU-3,4,5).
- .7 In-Floor Heating Manifolds (MNF-1,2,3,4,5) complete with associated Pumps (PU-6,7,8,9,10).
- .8 Domestic Hot Water Recirculation Pump (RCP-1)
- .9 Hydronic Unit Heaters (UH-1,2)
- .10 Natural Gas Unit Heater (UH-3)
- .11 Force Flow Heaters (FF-1,2,3)
- .12 Exhaust Fans (EF-2 & EF-3)
- .13 Electric Baseboard Heater (EBB-1, EBB-2)\_
- .14 Water Softener (WS-1)
- .2 All motorized dampers, actuators, control valves and devices required by this Section (unless noted otherwise).
- .3 The controls contractor shall be responsible for mounting and wiring all remote-mounted sensors and controls supplied with vendor-supplied equipment.

#### **1.4 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.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 All products used in this project installation shall be new and currently under manufacture and shall have been applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the Contract Administrator in writing. Spare parts shall be available for at least five years after completion of this Contract.

#### **2.2 POWER SUPPLIES AND LINE FILTERING**

- .1 Control transformers shall be CSA approved. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service in accordance with CEC requirements. Limit connected loads to 80% of rated capacity.



## **2.3 THERMOSTATS AND TEMPERATURE SENSORS**

- .1 Provide wall-mounted thermostats and/or space temperature sensors suitable for specified operation. Provide vandal proof protective covers for all units in public areas or where subject to damage.
- .2 All thermostats and/or space temperature sensors shall be low voltage unless otherwise specified.
- .3 Thermostats shall be multi-stage and feature 24/7 programmability.
- .4 Thermostats shall include multiple points of connection to control separate, dedicated heating and cooling systems without interconnecting control power.
- .5 Thermostats shall include an interlocked manual changeover feature to prevent simultaneous heating and cooling operation.

## **2.4 AUXILIARY CONTROL DEVICES**

- .1 Motorized control dampers, unless otherwise specified elsewhere, shall be as follows:
  - .1 Control dampers shall be the parallel or opposed blade type as below or as scheduled on drawings.
    - .1 Outdoor and/or return air mixing dampers shall be parallel blade, arranged to direct airstreams toward each other.
    - .2 Other modulating dampers shall be the opposed blade type.
    - .3 Two-position shutoff dampers on exhaust and air intake applications shall have insulated blades and may be parallel or opposed blade type with blade and side seals. See control drawings for locations of these dampers and dampers specifications for details.
  - .2 Damper frames shall be 13-gauge galvanized steel channel or 1/8 in. extruded aluminum with reinforced corner bracing.
  - .3 Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades are to be suitable for medium velocity performance (10 m/s [2000 fpm]). Blades shall be not less than 16 gauge.
  - .4 Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze or better.
  - .5 All blade edges and top and bottom of the frame shall be provided with replaceable butyl rubber or neoprene seals. Side seals shall be spring-loaded stainless steel. The blade seals shall provide for a maximum leakage rate of 50 L/s·m<sup>2</sup> (10 cfm per ft<sup>2</sup>) at 1000 Pa (4 in. w.g.) differential pressure. Provide airfoil blades suitable for a wide-open face velocity of 7.5 m/s (1500 fpm).
  - .6 Individual damper sections shall not be larger than 125 cm × 150 cm (48 in. × 60 in.). Provide a minimum of one damper actuator per section.
  - .7 Modulating dampers shall provide a linear flow characteristic where possible.
  - .8 Motorized dampers shall be installed next to duct access doors for ease in maintenance.
- .2 Electric damper/valve actuators.

- .1 The actuator shall have mechanical or electronic stall protection to prevent damage to the actuator throughout the rotation of the actuator.
  - .2 Where shown, for power-failure/safety applications, an internal mechanical, spring-return mechanism shall be built into the actuator housing.
  - .3 Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range.
  - .4 All 24 VAC/VDC actuators shall operate on Class 2 wiring.
  - .5 All non-spring-return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring-return actuators with more than 7 Nm (60 in.-lb) torque capacity shall have a manual crank for this purpose.
- .3 Control valves.
- .1 Control valves shall be two-way or three-way type for two-position or modulating service as shown. Perimeter radiators shall have electronic two-position valves.
  - .2 Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
    - .1 Water Valves:
      - .1 Two-way: 150% of total system (pump) head.
      - .2 Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
  - .3 Water Valves:
    - .1 Sizing Criteria:
      - .1 Two-position service: Line size.
      - .2 Two-way modulating service: Pressure drop shall be equal to 50% of the pressure difference between supply and return mains, or 5 psi, maximum.
      - .3 Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa (5 psi) maximum.
      - .4 Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.
      - .5 Valves 2½ in. and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
    - .2 Water valves shall fail normally open or closed, as scheduled on plans, or as follows:
      - .1 Water zone valves—normally open preferred.
      - .2 Other applications—as scheduled or as required by sequences of operation.
- .4 Binary Temperature Devices

- .1 Low-voltage space thermostat shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) set point range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
  - .2 Line-voltage space thermostat shall be bimetal-actuated, open contact type, or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, CSA approved for electrical rating, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
  - .3 Low-limit thermostats. Low-limit air stream thermostats shall be CSA approved, vapor pressure type, with an element of 6 m (20 ft) minimum length. Element shall respond to the lowest temperature sensed by any 30 cm (1 ft) section. The low-limit thermostat shall be manual reset only.
- .5 Temperature sensors
- .1 Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
  - .2 Duct sensors shall be single point or averaging. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m<sup>2</sup> (10 ft<sup>2</sup>) of duct cross section.
  - .3 Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the flow velocities in the pipe.
  - .4 Space sensors shall be equipped with set point adjustment, override switch, display, and/or communication port.
  - .5 Provide matched temperature sensors for differential temperature measurement.
- .6 Flow switches.
- .1 Flow-proving switches shall be either paddle or differential pressure type, as shown.
  - .2 Paddle type switches (water service only) shall be CSA approved, SPDT snap-acting with pilot duty rating (125 VA minimum) and shall have adjustable sensitivity with NEMA 1 enclosure unless otherwise specified.
  - .3 Differential pressure type switches (air or water service) shall be CSA approved, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as specified.
- .7 Relays
- .1 Control relays shall be CSA approved plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
  - .2 Time delay relays shall be CSA approved solid-state plug-in type with adjustable time delay. Delay shall be adjustable  $\pm 200\%$  (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.
  - .3 Override timers.
    - .1 Override timers shall be spring-wound line voltage, CSA approved, with contact rating and configuration as required by application. Provide 0-to-6-hour calibrated dial unless otherwise specified. Timer shall be suitable for flush mounting on control panel face and located on local control panels or where shown.

.8 Current switches

- .1 Current-operated switches shall be self-powered, solid-state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

.9 Pressure transducers

- .1 Transducer shall have linear output signal. Zero and span shall be field adjustable.
- .2 Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
- .3 Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.
- .4 Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Overrange limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and five-valve manifold.

- .10 Differential pressure type switches (air or water service) shall be CSA approved, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as shown.

.11 Pressure-Electric (PE) Switches.

- .1 Shall be metal or neoprene diaphragm actuated, operating pressure rated 0-175 kPa (0-25 psig), with calibrated scale setpoint range of 14-125 kPa (2-18 psig) minimum, CSA approved.
- .2 Provide one- or two-stage switch action SPDT, DPST, or DPDT, as required by application. Electrically rated for pilot duty service (125 VA minimum) and/or for motor control.
- .3 Shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
- .4 Shall have a permanent indicating gauge on each pneumatic signal line to PE switches.

.12 Local control panels

- .1 All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.
- .2 Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be CSA approved for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
- .3 Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

## **2.5 WIRING AND RACEWAYS**

- .1 General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 16.
- .2 All insulated wire to be copper conductors, UL labelled for 90°C minimum service.

## **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 General:
  - .1 The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Contract Administrator for resolution before rough-in work is started.
  - .2 The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Contract Administrator for resolution before rough-in work is started.
  - .3 The contractor shall examine the drawings and specifications for other parts of the Work. If head room or space conditions appear inadequate or if any discrepancies occur between the plans and the contractor's work and the plans and the work of others the contractor shall report these discrepancies to the Contract Administrator and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the Work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be made by—and at the expense of—this contractor.
  - .4 All items shall be installed in accordance with manufacturer's instructions. All conduit shall be independently supported from the structure in an approved manner.
  - .5 The control equipment and connecting conduit and wire shall be installed in a neat and workmanlike manner by personnel skilled in this type of installation. All tubing, conduit and plenum rated cable shall be run in an approved manner; conduit shall be run parallel to or at right angles to the building structure. All conduit, tubing, and plenum cable shall be concealed in all finished spaces. Conduit containing wire or non-metallic tubing may be installed exposed in mechanical rooms or areas where other piping is run exposed.
  - .6 Non-metallic tubing and plenum cable may be used in concealed accessible spaces provided such installation is allowed by local codes.
  - .7 All electrical work shall be installed by experienced personnel and conform to CEC and all local codes. Where requirements of Division 16 differ from those contained herein, Division 26 section shall take precedence.

### **3.3 GENERAL WORKMANSHIP**

- .1 Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

- .2 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- .3 Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- .4 All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

### **3.4 WIRING**

- .1 All control and interlock wiring shall comply with the CEC and local electrical codes and Electrical section of this specification. Where the requirements of this section differ from those in the Electrical section, the requirements of this section shall take precedence.
- .2 All CSA Class 1 (line voltage) wiring shall be CSA approved in approved raceway according to CSA and Division 26 requirements.
- .3 All low-voltage wiring shall meet CSA Class 2 requirements. (Low-voltage power circuits shall be sub fused when required to meet Class 2 current limit.)
- .4 Where CSA Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are CSA approved for the intended application. For example, cables used in ceiling plenums shall be CSA approved specifically for that purpose.
- .5 All wiring in mechanical, electrical, or service rooms—or where subject to mechanical damage shall be installed in raceway at levels below 3 m (10 ft).
- .6 Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- .7 Do not install wiring in raceway containing tubing.
- .8 Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and *neatly* tied at 3 m (10 ft) intervals.
- .9 Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- .10 All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
- .11 All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- .12 Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers.
- .13 All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

- .14 Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
- .15 Size of raceway and size and type of wire shall be the responsibility of the contractor, in keeping with the manufacturer's recommendations and CSA requirements, except as noted elsewhere.
- .16 Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- .17 Use coded conductors throughout with conductors of different colors.
- .18 Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- .19 Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g., steam pipes or flues).
- .20 Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- .21 Adhere to this specification's Division 16 requirements where raceway crosses building expansion joints.
- .22 Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
- .23 The contractor shall terminate all control and/or interlock wiring and shall maintain updated (asbuilt) wiring diagrams with terminations identified at the job site.
- .24 Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.
- .25 Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

### **3.5 COMMUNICATION WIRING**

- .1 The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification.
- .2 All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
- .3 Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

- .4 Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- .5 contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
- .6 When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer's instructions.
- .7 All runs of communication wiring shall be un-spliced length when that length is commercially available.
- .8 All communication wiring shall be labelled to indicate origination and destination data.

### **3.6 INSTALLATION OF SENSORS**

- .1 Install sensors in accordance with the manufacturer's recommendations.
- .2 Mount sensors rigidly and adequately for the environment within which the sensor operates.
- .3 Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- .4 All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
- .5 Sensors used in mixing plenums shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
- .6 Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m of sensing element for each 1 m<sup>2</sup> (1 ft of sensing element for each 1 ft<sup>2</sup>) of coil area.
- .7 All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
- .8 Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.
- .9 Differential air static pressure.
  - .1 Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
  - .2 Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.



- .3 Building Static Pressure: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover.
- .4 The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
- .5 All pressure transducers, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
- .6 All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee.

### **3.7 FLOW SWITCH INSTALLATION**

- .1 Use correct paddle for pipe diameter.
- .2 Adjust flow switch in accordance with manufacturer's instructions.

### **3.8 ACTUATORS**

- .1 Mount and link control damper actuators according to manufacturer's instructions.
  - .1 To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
  - .2 Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
  - .3 Provide all mounting hardware and linkages for actuator installation.
- .2 Electric/Electronic
  - .1 Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.
  - .2 Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

### **3.9 WARNING LABELS**

- .1 Permanent warning labels shall be affixed to all equipment that can be automatically started remotely.
  - .1 Labels shall use white lettering (12-point type or larger) on a red background.
  - .2 Warning labels shall read as follows:  
**C A U T I O N**  
This equipment is operating under automatic control  
and may start or stop at any time without warning.  
Switch disconnect to "Off" position before servicing.
- .2 Permanent warning labels shall be affixed to all motor starters and all control panels that are connected to multiple power sources utilizing separate disconnects.

.1 Labels shall use white lettering (12-point type or larger) on a red background.

.2 Warning labels shall read as follows:

**C A U T I O N**

This equipment is fed from more than one  
power source with separate disconnects.

Disconnect all power sources before servicing.

**3.10 IDENTIFICATION OF HARDWARE AND WIRING**

.1 All wiring and cabling, including that within factory fabricated panels, shall be labelled at each end within 5 cm (2 in.) of termination with the address or termination number.

.2 All pneumatic tubing shall be labelled at each end within 5 cm (2 in.) of termination with a descriptive identifier.

.3 Permanently label or code each point of field terminal strips to show the instrument or item served.

.4 Identify control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.

.5 Identify all other control components with permanent labels. All plug-in components shall be labelled such that removal of the component does not remove the label.

.6 Identify room sensors relating to terminal box or valves with nameplates.

.7 Manufacturers' nameplates and UL or CSA labels are to be visible and legible after equipment is installed.

.8 Identifiers shall match record documents.

**3.11 CONTROL SYSTEM CHECKOUT AND TESTING**

.1 Start-up Testing: All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Contract Administrator is notified of the system demonstration.

.1 The contractor shall furnish all labour and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.

.2 Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

.3 Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers' recommendations.

.4 Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

- .5 Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.
- .6 Verify that the system operation adheres to the sequences of operation.
- .7 Alarms and Interlocks:
  - .1 Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
  - .2 Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
  - .3 Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
- .2 Testing and balancing shall also be performed according to the Testing and Balancing section.

### **3.12 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE**

- .1 Refer to Section 21 05 01 – Common Work Results for Mechanical for commissioning details and requirements.

### **3.13 CLEANING**

- .1 The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- .2 At the completion of Work in any area, the contractor shall clean all Work, equipment, etc., keeping it free from dust, dirt, and debris, etc.
- .3 At the completion of Work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

### **3.14 TRAINING**

- .1 Provide training sessions for building personnel.
- .2 Train the designated staff of the building to enable them to do the following:
  - .1 Day-to-day Operators:
    - .1 Proficiently operate the system
    - .2 Understand system operation.

- .3 Adjust and change system set points, time schedules, and holiday schedules
  - .4 Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
  - .5 Understand system drawings and Operation and Maintenance manual.
  - .6 Understand the job layout and location of control components.
- .3 Provide course outline and materials. The instructor(s) shall provide one copy of training material per student.
  - .4 The instructor(s) shall be factory-trained instructors experienced in presenting this material.
  - .5 One eight (8) hour training session or two (2), four (4) hour training sessions are required.
  - .6 **Provide a follow up training sessions six (6) months after the first training session as described above.**

### 3.15 SEQUENCE OF OPERATION

- .1 General:
  - .1 Controls contractor shall enter/confirm the base schedule of the buildings occupied times and shall train designated building personnel with the new system controls.
  - .2 Controls contractor shall meet with mechanical engineer and go over the sequence of operations prior to submitting shop drawings. Make changes to sequences where required as directed by the engineer.
  - .3 **Heating Mode:** When outdoor temperature is equal to or below heating start set point. (Operator Adjustable, initially set to 58 °F).  
**Cooling Mode:** When outdoor air temperature is above heating start set point.
- .2 Energy Recovery Ventilator (ERV-1), including integral motorized dampers, preheat coil, and post heat coil (HC-1):
  - .1 The unit shall be provided with factory mounted and factory wired microprocessor controls and sensors.
  - .2 The unit controller shall be BACnet compatible for future expansion.
  - .3 Unit must be able to provide a 24VAC 20VA power supply for external accessories.
  - .4 Every component shall be properly protected against current overload.
  - .5 Each motor must have its own magnetic contactor and thermal overload.
  - .6 The control panel must be equipped with a screen and display to monitor the unit, view and reset alarms and set the parameters of the controller without the use of an external computer.
  - .7 Factory supplied remote 24V keypad and display.
  - .8 ERV shall operate continuously during occupied hours and shall be off during unoccupied hours. Intake and Discharge dampers shall be proven fully open before ERV starts and shall close fully when ERV shuts down.

- .9 Low temperature limit: Unit will stop if the supply air temperature is below the adjustable setpoint.
- .10 Electric pre-heat coil:
  - .1 Frost prevention must be based on a temperature sensor.
  - .2 Freezing of the core must be avoided by using an electrical preheat coil that will preheat the outside air and maintain an entering air temperature to the core above the set point.
  - .3 The electrical preheat coil must be installed inside the unit.
  - .4 The electrical preheat coil must be of the Open Element type and be made of galvanized steel.
  - .5 The electrical preheat coil must be controlled using a temperature sensor located inside the unit and use a SSR modulating controller.
  - .6 The set point must be adjusted at the shop.
  - .7 The electrical preheat coil must be provided with contactors, controls, thermal protections, a low airflow switch and a SSR modulating controller.
- .11 Fresh air damper: Power and control (24VAC, 10VA) for fresh air damper shall be controlled internal to the unit.
- .12 Exhaust air damper: Power and control (24VAC, 10VA) for exhaust damper shall be controlled internal to the unit.
- .13 Hydronic post heat coil (HC-1):
  - .1 The hot water post-heat coil must be installed inside the unit.
  - .2 Unit shall automatically control supply air temperature according to sensor located in the supply air port to maintain 72°F (adjustable) setpoint.
- .14 ERV shall be capable of being set to three separate speeds (high, medium, and low) via internal VFDs by operator input on the remote interface.
- .3 Air Handling Units (AHU-1,2,3,4,5) complete with associated Condensing Units (CU-1,2,3,4,5):
  - .1 User Temperature Setting: The user sets the desired temperature using low-voltage thermostat in cooling mode.
  - .2 Variable-speed air handler and condensing unit to operate via 24 V 2-stage thermostat inputs. Onboard equipment logic shall manage variable-speed compressor ramping and indoor blower CFM based on 24 V thermostat demands.
- .4 Make Up Air Unit (MUA-1) complete with associated Range Hood (RHD-1) and Kitchen Exhaust Fan (EF-1).
  - .1 Controls shall be a fully factory-packaged, integral master control panel bundle.
  - .2 Manual activation of the hood switch turns ON EF-1 and MUA-1 concurrently. Both fans run at constant volumes pre-set via factory Motor Speed Controllers (MSC) during balancing. Turning the switch off stops both units.
  - .3 Shipped-loose room temperature sensor shall detect space temperature. If space temperature rises above setpoint, the master panel automatically overrides hood switch to start both EF-1 and MUA-1.
  - .4 Fire Emergency State: Upon activation of the local fire suppression system or the building fire alarm:

- .1 EF-1 is forced ON at 100% capacity.
- .2 MUA-1 shuts OFF immediately and its isolation damper closes.
- .3 Hood canopy lights are de-energized.
- .4 The master panel trips a 120V shunt-trip relay to shut off gas supply to all cooking equipment. System requires a manual reset at the panel once cleared.
- .5 Wall Mounted Heat Pump (HP-1) complete with associated Condensate Pump (CP-1):
  - .1 Controlled by remote 24V wall mounted Thermostat complete with vandal proof locking cover.
- .6 Hydronic Heating System:
  - .1 The plant (boilers/main pumps) shall run automatically via a Tekmar controller based on outdoor air temperature by an outdoor temperature sensor.
  - .2 Terminal equipment (unit heaters/in-floor heating manifolds) shall be controlled directly by local thermostats, independent of the Tekmar controller.
  - .3 Main Loop Hydronic Circulation Pumps (PU-1,2)
    - .1 Pumps shall operate in a Lead/Lag configuration. Only one pump shall operate at any given time while the other pump remains in standby.
    - .2 The designation of "Lead" and "Lag" pump shall automatically alternate based on a user-defined schedule to ensure equal runtime on both units.
    - .3 Upon a system start signal, the designated "Lead" pump shall start. A pump-mounted differential pressure switch shall prove pump operation.
    - .4 If the operating Lead pump fails to prove flow within 60 seconds, or if its motor thermal overload trips, an alarm shall be generated, the failed pump shall be de-energized, and the standby "Lag" pump shall automatically start to maintain system circulation.
  - .4 Boilers (B-1,2,3) complete with associated Boiler Pumps (PU-3,4,5).
    - .1 The boiler shall have a minimum turndown ratio of 8:1 to maintain supply water temperature at setpoint.
    - .2 The boiler shall be controlled via an outdoor air sensor to modulate the supply water temperature setpoint to suit outdoor ambient conditions.
    - .3 The boiler pump is activated whenever the boiler is operating.
    - .4 The system enters a standby mode, ready to respond to the next heating demand.
  - .5 In-Floor Heating Manifolds (MNF-1,2,3,4,5) complete with associated Pumps (PU-6,7,8,9,10).
    - .1 User Temperature Setting: The user sets the desired temperature using low-voltage thermostat in heating mode.
    - .2 If the temperature is below the setpoint: The thermostat signals the 3-way mixing valve to modulate open to the coil.
    - .3 If the temperature is at or above the setpoint: The thermostat signals the 3-way mixing valve to modulate to the bypass position.
    - .4 3-Way Mixing Valve: Automatically modulates between coil and bypass ports based on the thermostat's signal.
  - .6 Hydronic Unit Heaters (UH-1,2):
    - .1 Controlled by remote 24V wall mounted Thermostat

- .2 If the temperature is below the setpoint: The thermostat signals the 3-way mixing valve to modulate open to the coil.
- .3 If the temperature is at or above the setpoint: The thermostat signals the 3-way mixing valve to modulate to the bypass position.
- .4 Fan/Blower: Activates or deactivates automatically for air circulation based on heating demand or coil temperature.
- .7 Domestic Hot Water Recirculation Pump (RCP-1):
  - .1 Pump shall operate based on a combination of an automatic timer and aquastat provided by the pump manufacturer.
  - .2 Domestic hot water recirculation pump shall operate when the ON time conditions are met and the temperature sensor in the domestic hot water return line drops to 38°C (100°F) (adjustable setpoint).
  - .3 Domestic hot water recirculation pump shall shut off when the OFF time conditions are met or if the temperature sensor in the domestic hot water return line reaches 49°C (120°F) (adjustable setpoint).
- .7 Natural Gas Unit Heater (UH-3):
  - .1 Controlled by remote 24V wall mounted Thermostat.
  - .2 If the temperature is below the setpoint: The thermostat signals to ignite the burner.
  - .3 If the temperature is at or above the setpoint: The thermostat signals to turn off the burner.
  - .4 Venter Motor: Operates automatically to ensure proper combustion air intake and venting.
  - .5 Fan/Blower: Activates or deactivates automatically for air circulation.
- .8 Force Flow Heaters (FF-1,2,3):
  - .1 Controlled by remote 24V wall mounted Thermostat.
- .9 Electric Baseboard Heater (EBB-1, EBB-2):
  - .1 Controlled by remote 24V wall mounted Thermostat.
- .10 Cooling Exhaust Fans (EF-2 & EF-3):
  - .1 Controlled by remote electronic wall mounted Thermostat.
  - .2 If the temperature is above the setpoint: Energize the exhaust fan.
  - .3 If the current temperature is at or below the setpoint: Deactivate the exhaust fan.
- .11 Water Softener (WS-1):
  - .1 Unit controlled by factory supplied controller.

**END OF SECTION**

Part 1 General

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for 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 B149.1HB-00, Natural Gas and Propane Installation Code Handbook.
  - .2 CAN/CSA B149.2-00, Propane Storage and Handling 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.
- .2 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15- Sustainable Requirements: Construction.
- .3 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
  - .2 Indicate on manufacturers catalogue literature following: valves.



- .3 Submit WHMIS MSDS in accordance with Section 01 47 15- Sustainable Requirements: Construction and Section 02 81 01- Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.
  - .4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
  - .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .6 Instructions: submit manufacturer's installation instructions.
  - .7 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00- Closeout Submittals.
- 1.4** QUALITY ASSURANCE
- .1 Pre-Installation Meeting:
    - .1 Convene pre-installation meeting one week prior to beginning on-site installations work of this Section in accordance with Section 01 32 16.06- Construction Progress Schedule - Critical Path Method (CPM) Section 01 32 16.07- Construction Progress Schedules - Bar (GANTT) Chart.
      - .1 Verify project requirements.
      - .2 Review installation and substrate conditions.
      - .3 Co-ordination with other building subtrades.
      - .4 Review manufacturer's installation instructions and warranty requirements.
  - .2 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 Waste Management and Disposal:
    - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
    - .2 Divert unused materials from landfill to recycling facility as approved by Consultant.
- 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 NPS2 1/2 and over, plain end.

- .2 Copper tube: to ASTM B837.

## **2.2 JOINTING MATERIAL**

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: non-metallic flat.
- .4 Brazing: to ASTM B837.

## **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 Copper pipe fittings, screwed, flanged or soldered:
  - .1 Cast copper fittings: to ASME B16.18.
  - .2 Wrought copper fittings: to ASME B16.22.

## **2.4 VALVES**

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

## **2.5 PRESSURE REDUCING VALVES (PRVS)**

- .1 Materials: epoxy-coated aluminum housing, reinforced buna N diaphragm and valve seat.
- .2 Pipe sizes 3/8"-2" diameter
- .3 Maximum inlet pressure w/ vent limiter 10 psig max.
- .4 Self-operating regulator with vent limiting option (ventless).

## **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 Install in accordance with Section 23 05 05- Installation of Pipework, CAN/CSA B149.2, applicable Provincial/Territorial Codes, CAN/CSA B149.1 supplemented as specified.
- .2 Install drip points:
  - .1 At low points in piping system.
  - .2 At connections to equipment.

**3.3 VALVES**

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

**3.4 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Test system in accordance with CAN/CSA B149.2, CAN/CSA B149.1 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 product[s], 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 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
    - .2 Twice during progress of work at 25% and 60% complete.
    - .3 Upon completion of work, after cleaning is carried out.
- .3 Obtain reports within 3 days of review and submit immediately to Contract Administrator.
- .4 Verification requirements in accordance with Section 01 47 17- Sustainable Requirements: Contractor's Verification, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.

- .6 Local/regional materials.
  - .7 Certified wood.
  - .8 Low-emitting materials.
- .5 Performance Verification:
  - .1 Refer to Section 23 08 01- Performance Verification of Mechanical Piping Systems.
- 3.5 ADJUSTING**
  - .1 Purging: purge after pressure test in accordance with CAN/CSA B149.2, CAN/CSA B149.1.
  - .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.
- 3.6 CLEANING**
  - .1 Cleaning: in accordance with Section 23 08 02- Cleaning and Start-Up of Mechanical Piping Systems, CAN/CSA B149.1, and CAN/CSA B149.2, supplemented as specified.
  - .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 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
  - .2 ASME B16.3, Malleable Iron Threaded Fittings: Classes 150 and 300.
  - .3 ASME B16.5, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.
  - .4 ASME B16.9, Factory-Made Wrought Buttwelding Fittings.
  - .5 ASME B18.2.1, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Loded Head and Lag Screws (Inch Series).
  - .6 ASME B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
- .3 ASTM International
  - .1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - .3 ASTM A536, Standard Specification for Ductile Iron Castings.
  - .4 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.
  - .5 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .6 ASTM E202, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 CSA International
  - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
  - .2 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
  - .1 MSS-SP-67, Butterfly Valves.
  - .2 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

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 hydronic systems and include product characteristics, performance criteria, physical size, finish, and limitations.
  - .3 Shop Drawings:
    - .1 Indicate on drawings:
      - .1 Components and accessories.
- 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 hydronic systems for incorporation into manual.
    - .1 Include special servicing requirements.
- Part 2 Products
  - 2.1 PIPE
    - .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
      - .1 To NPS 6: Schedule 40.
  - 2.2 PIPE JOINTS**
    - .1 Steel pipe:
      - .1 NPS 2 and under: screwed fittings with PTFE tape.
      - .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.
      - .3 Roll grooved: standard or rigid coupling to CSA B242.
      - .4 Flanges: plain or raised face, slip-on or weld neck.
      - .5 Orifice flanges: slip-on raised face, 2100 kPa.
      - .6 Flange gaskets: to ANSI/AWWA C111/ A21.11.
      - .7 Pipe thread: taper.
      - .8 Bolts and nuts: to ANSI B18.2.1 and ANSI/ASME B18.2.2.
      - .9 Roll grooved coupling gaskets: type EPDM.
  - 2.3 FITTINGS**
    - .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
    - .2 Pipe flanges and flanged fittings:
      - .1 Cast iron: to ASME B16.1, Class 125.
      - .2 Steel: to ASME B16.5.
    - .3 Butt-welding fittings: steel, to ASME B16.9.

- .4 Unions: malleable iron
  - .5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M or ductile iron to ASTM A536.
- 2.4 VALVES
- .1 Connections:
    - .1 NPS 2 and smaller: screwed ends.
    - .2 NPS 2-1/2 and larger: flanged or grooved ends.
  - .2 Ball Valves
    - .1 NPS 2 and under:
      - .1 To ASTM B62, 4 MPa WOG, bronze body, screwed ends, TFE seal, hard chrome solid ball, Teflon seats and lever handle.
    - .2 Acceptable product: Toyo Figure 5044A, Crane, Grinnell, or approved equivalent.
  - .3 Flow Balance Valves:
    - .1 Size: 13 mm – 63 mm
      - .1 Forged brass body, nickel-plated brass ball, Teflon seals, combination P/T test valves and air vents, memory stop with graduated markings. Valve comes fully assembled.
      - .2 Valve pressure drop shall not exceed 9 kPa (3' head).
      - .3 Acceptable Product: "Speedset", "Bell & Gossett", "Armstrong" or approved equal.
  - .4 Butterfly valves: to MSS-SP-67:
    - .1 NPS 2 1/2 and over: Lug type:
    - .2 Pressure rating for tight shut-off at temperatures up to maximum for seat material.
      - .1 NPS 2 - 12: 200 psig.
    - .3 Minimum seat temperature ratings to 135°C.
    - .4 Application: on-off operation.
    - .5 Operators:
      - .1 NPS 2 - 6: handles capable of locking in any of ten (10) positions - 0° to 90°. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel. Standard coating: black lacquer.
    - .6 Compatible with ANSI Class 125/Class 150 flanges.
    - .7 Construction:
      - .1 Body ductile iron.
      - .2 Disc: aluminum bronze.
      - .3 Seat: EPDM.

- .4 Shaft: 316 stainless steel.
  - .5 Taper pin: 316 SS.
  - .6 Key: stainless.
  - .7 O-Ring: EPDM.
  - .8 Bushings: luberized bronze.
  - .8 Acceptable Product: "Bray" Series 31 or approved equivalent.
- .5 Balancing Valves, for TAB:
  - .1 Sizes: Calibrated balancing valves, as specified this section.
  - .2 NPS2 and under:
    - .1 Threaded bronze body construction, brass ball, TFE seat rings c/w memory stop, and differential pressure readout ports.
    - .2 Acceptable product: Bell & Gossett Circuit Setter plus Model CB or approved equivalent.
  - .3 NPS 2-1/2 and over:
    - .1 Flanged cast iron body construction, c/w memory stop, and differential pressure readout ports.
    - .2 Acceptable Product: Bell & Gossett Circuit Setter Model CB or approved equivalent.
- .6 Control Valves: Supplied by Section 23 09 33, installed by Section 23 21 13.02. Section 23 21 13.02 shall provide reducers where required if the control valve is not the same size as the pipe.

### 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 hydronic systems installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Contract Administrator.
  - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

#### 3.2 PIPING INSTALLATION

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

#### 3.3 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 Tape joints in prefabricated insulation on valves installed in chilled water mains.
- 3.4 CLEANING, FLUSHING AND START-UP
  - .1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.
- 3.5 TESTING
  - .1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.
- 3.6 BALANCING
  - .1 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures and tolerances.
  - .2 CLEANING
    - .1 Upon completion remove surplus materials, rubbish, tools, and equipment.
- 3.7 PROTECTION
  - .1 Protect installed products and components from damage during construction.
  - .2 Repair damage to adjacent materials caused by hydronic systems installation.

END OF SECTION

Part 1 General

1.1 REFERENCES STANDARDS

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
  - .2 ASTM F876, Standard Specification for Cross-Linked Polyethylene (PEX) Tubing.
  - .3 ASTM F877, Standard Specification for Cross-Linked Polyethylene (PEX) Plastic Hot and Cold Water Distribution Systems.
  - .4 ASTM F2788, Standard Specification for Metric-Sized PEX Pipe.
  - .5 ASTM F1960, Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-Linked Polyethylene (PEX) Tubing.
- .2 Canadian Standards Association International (CSA)
  - .1 CSA B137.5, Cross-Linked Polyethylene (PEX) for Pressure Applications.
  - .2 CSA B214, Installation Code for Hydronic Heating Systems.
- .3 German Institute of Standards (DIN):
  - .1 DIN 4726, Warm Water Floor Heating Systems and Radiator Connections – Piping Made Out of Plastic Materials.
- .4 Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .5 Plastic Pipe Institute (PPI):
  - .1 PPI Technical Report TR-4.
- .6 Underwriters Laboratories of Canada (ULC)
  - .1 ULC 101 Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .2 ULC 115 Standard Method of Fire Tests of Firestop Systems.
  - .3 ULC 102.2 Standard for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.

1.2 SYSTEM DESCRIPTION

- .1 Provide hydronic radiant floor heating system which has been manufactured, fabricated, and installed to comply with regulatory agencies and to maintain performance criteria stated by manufacturer without defects, damage, or failure. The floor loop design shall be capable of providing the specified heating loads without altering the flow output of the specified circulators.

1.3 SUBMITTALS

- .1 Submit listed submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Submit product data for specified products.
  - .1 Submit verification of Standard Grade hydrostatic pressure ratings from Plastic Pipe Institute in accordance with TR-4. The following 3 Standard Grade ratings are required: 200°F (93°C) at 80 psi (551 kPa); 180°F (82°C) at 100 psi (689 kPa) and 73.4°F (23°C) at 160 psi (1102 kPa).

- .2 Submit Product Submittal sheets for tubing, manifolds, connection system, loop and/or manifold actuators, thermostats, and zone controls.
- .3 Performance Data: Submit manufacturer's design drawings and calculations showing compliance with meeting heat loads based on maximum 125°F average heating supply water. Additional design calculations shall include:
  - .1 Flow rate in each loop.
  - .2 Head loss in each loop.
  - .3 Surface temperature(s).
  - .4 Loop design temperature drop(s).
  - .5 Loop spacing(s).
  - .6 Loop length(s).
- .4 Regulatory Listings: Submit applicable UL, ULC, Warnock Hersey, Intertek or QAI and CSA or NSF listings as proof of compliance with National Building Codes. Listings shall include the following.
  - .1 Submit listings that indicate that the PEX tubing system has been listed to ULC 101 when the PEX tubing is incorporated in and traverses a ULC 101 floor/ceiling assembly. The listings must be appropriate to assemblies on site.
  - .2 Submit listings that indicate that the PEX tubing firestop system has been listed to ULC 115 when the PEX tubing penetrates a fire separation. The listings must be appropriate to assemblies on site.
  - .3 Submit listings that indicate that the PEX tubing has been listed to ULC 102.2 for maximum 25 flame spread and maximum 50 smoke developed.
- .5 Shop Drawings: Submit print-out of piping manufacturer's design and shop drawings indicating loop layout, manifold locations, initial loop flow balance settings, floor profiles, floor coverings and product components, including anchorage, accessories, and finishes.
  - .1 Include installation drawings of tubing layout indicating loop length, loop spacing, tube size and detail notes to aid in installation of system.
  - .2 No fabrication shall be performed until approval is given.
- .6 Quality Assurance: Submit the following:
  - .1 Copy of certificate indicating that the installer is certified in the installation of the manufacturer's products.
  - .2 Manufacturer's installation instructions.
  - .3 Installer shall provide in writing to the project owner that the PEX tubing and components furnished under this specification conforms to the material and mechanical requirements specified herein.
- .7 Closeout Submittals:
  - .1 Submit Operation and maintenance (O&M) data for installed products, including methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.
  - .2 Submit warranty documents specified herein.
  - .3 Submit manufacturer's field reports specified herein.
  - .4 Submit final "As-Built" loop layout drawing.
  - .5 Submit copy of piping manufacturer's design software printout.

- .6 Submit project record documents for installed materials.

#### 1.4 QUALITY ASSURANCE

##### .1 Qualifications:

- .1 Installer Qualifications: Installer shall be experienced in performing work of this section and has specialized in installation of work similar to that required for this project.
- .2 Installation Qualifications: Installation must be by skilled tradesmen holding a trade qualification license or apprentices under the supervision of a licensed tradesman.
- .3 Installer Qualifications: Installer must be recognized by the manufacturer as a "Trained Installer".

##### .2 Regulatory Requirements: ensure Work is performed in compliance with applicable Provincial /Territorial regulations. PEX tubing and components shall be installed in full compliance with all Federal, Provincial and Municipal codes, standards and requirements. In particular:

- .1 PEX tubing shall be listed to a maximum 25 flame spread and maximum of 50 smoke developed per the requirements of ULC 102.2.
- .2 PEX tubing penetrating a fire separation shall be sealed per ULC 115.
- .3 PEX tubing contained within a ULC 101 floor/ceiling assembly shall be listed per ULC 101.

##### .3 Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, floor coverings, manufacturer's installation instructions and manufacturer's warranty requirements.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with the manufacturer's written instructions.
- .2 Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- .3 Deliver materials to job site in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .4 Storage and Protection: Store materials protected from exposure to harmful weather and job site conditions.
  - .1 Store PEX tubing in original packaging or under cover to avoid dirt or foreign material from being introduced into the tubing.
  - .2 Do not expose PEX tubing to direct sunlight for more than 30 days. If construction delays are encountered, installer is responsible for providing cover to portions of tubing exposed to direct sunlight.

#### 1.6 WARRANTY

- .1 Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- .2 PEX Manufacturer's Warranty: Warranty must meet the following conditions:

- .1 PEX tubing shall carry a 25-year non-prorated warranty against failure due to defect in material or workmanship and;
- .2 Manifolds and fittings shall carry a 5-year non-prorated warranty against failure due to defect in material or workmanship and;
- .3 Controls and electrical components shall carry a 2-year non-prorated warranty against failure due to defect in material or workmanship and;
- .4 Warranty shall provide for repair or replacement of any tube or fittings which are proven to be defective and pay for consequential damages and;
- .5 Warranty shall be transferable to subsequent owners and;
- .6 Effective Warranty: Current manufacturer's warranty at time of installation and;
- .7 Warranty Period: Warranty shall commence on date of Substantial Completion.

#### 1.7 SYSTEM START-UP AND TRAINING

- .1 Training: Instruct Owner's personnel in operation and maintenance of installed units. Provide manufacturer's installation, operation, and maintenance instructions for installed units.

#### 1.8 ACCEPTED MANUFACTURERS

- .1 Where a Manufacturer's name is specified, it is for the purpose of setting a standard of quality, performance, capacity, appearance and serviceability. Accepted Manufacturers listed below are expected to be capable of provided the specified material or equipment. Although a particular Manufacturer may be listed below, it is mandatory that every product provided meets all parameters and standards of the specification.
- .2 Approval as an Equal or Alternate product does not absolve the supplier of the obligation to meet all clauses of these specifications.
- .3 The following Manufacturers are acceptable.
- .4 

Equipment	Acceptable Manufacturers
Radiant floors	Heatlink or approved equal

#### Part 2 Products

##### 2.1 RADIANT FLOOR HEATING SYSTEM

- .1 Tube Materials: Tube shall be cross-linked polyethylene (PEX) manufactured by PEX-a method.
  - .1 Oxygen Barrier: Tube shall have an oxygen barrier capable of limiting oxygen migration through the tube wall to no greater than 0.10 g/m<sup>3</sup>/day at 104°F (40°C) water temperature per the requirements of DIN 4726.
  - .2 PEX tubing shall be CSA B137.5 listed for both hydronic and potable water distribution systems.
  - .3 PEX tubing shall be manufactured in accordance with ASTM F876 and ASTM F877. The tube shall be listed to ASTM by an independent third-party agency.
  - .4 PEX tubing shall be ASTM F876 tested and approved for excessive temperature and pressure for 725 hours at 210°F (99°C) at 150 psi (1035 kPa).

- .5 PEX tubing shall have Standard Grade hydrostatic design and pressure ratings of 200°F (82°C) at 80 psi (551 kPa), 180°F (82°C) at 100 psi (689 kPa), and 73.4°F (23°C) at 160 psi (1102 kPa). Temperature and pressure ratings shall be issued by the Plastic Pipe Institute (PPI), a division of the Society of the Plastic Industry (SPI).
- .6 Minimum bend radius for cold bending of the PEX tubing shall not be less than 6 times the outside diameter. Bends with a radius less than stated shall require the use of a bend support as supplied by tube manufacturer.
- .7 PEX tubing dimensions shall be:
  - .1 5/8-inch nominal inside diameter in accordance with ASTM F876.
- .2 Manifolds:
  - .1 Manifold shall be fully assembled and mounted on a durable bracket with air vent and drain on the return manifold sections. Refer to mechanical equipment schedules for flowrate and loop requirements. Manifold shall be capable of full flow isolation on each loop.
    - .1 Manifold Type: Recessed manifold.
    - .2 Manifolds shall be supplied by the PEX tubing manufacturer.
    - .3 Supply manifolds shall have flow meters to balance each loop.
    - .4 Return manifolds shall have isolation valves for each loop.
    - .5 Manifolds shall have integral manual air vent and drain.
    - .6 Manifolds shall be manufactured from stainless steel.
    - .7 Manifolds shall be supplied with manufacturers mounting brackets.
    - .8 Manifolds shall be equipped with integral pumps.
      - .1 Refer to mechanical equipment schedule for pump performance.
- .3 Manifold Isolation Ball Valves:
  - .1 Manifolds shall be isolated at the inlet and outlet of the manifold with full flow ball valves.
  - .2 The supply ball valve shall have an internal strainer.
  - .3 Isolation Ball Valve Type: in accordance with 23 21 13.02 Hydronic Systems - Steel.
  - .4 Isolation ball valves shall be supplied by the PEX tubing manufacturer.
- .4 Fitting Materials:
  - .1 Fittings shall be manufactured of solid brass.
  - .2 Fittings shall be PEX-a compression fitting, PEX-a cold expansion type fitting, or PEX-a press insert type fitting.
  - .3 Fittings shall be supplied by the PEX tubing manufacturer.
  - .4 PEX-a compression fitting shall be an assembly consisting of compression ring and compression nut.
  - .5 PEX-a cold expansion type fitting shall be an assembly consisting of insert and PEX-a cold expansion ring.
  - .6 PEX-a press insert type fitting shall be a solid assembly consisting of solid brass.
- .5 Supply and Return Piping to Manifolds:

- .1 Piping run in heated spaces shall be cross-linked tubing with oxygen diffusion barrier capable of limiting oxygen migration through the tube wall to no greater than 0.10 g/m<sup>3</sup>/day at 104°F (40°C) water temperature per the requirements of DIN 4726. Supply and return piping run underground shall be cross-linked tube encased in a pre-insulated polyethylene jacket.
  - .1 Supply and Return Piping Type: Heatlink PEX-a Tubing with Oxygen Barrier or approved equal.

## 2.2 ACCESSORIES

- .1 Controls in accordance with Section 23 09 33 – Electric and Electronic Control System for HVAC.
- .2 Manifold Cabinets: All manifolds shall be recessed metal cabinets with no openings. The cabinets shall be lockable and be able to be painted. The cabinets shall be supplied by the PEX tubing manufacturer.

## 2.3 RELATED MATERIALS

- .1 For hydronic systems other than radiant floor heating, refer to Section 23 05 05 - Installation of PIPework and Section 23 21 14 – Hydronic Specialties.
- .2 Examine all other portions of the subcontract documents for work or other terms and conditions related to the work of this section.
- .3 Provide all work as required for the support and accommodation of related materials.

## Part 3 Execution

### 3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Comply with manufacturer's product data, including product technical bulletins, installation instructions and product packaging instructions for installation.

### 3.2 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for radiant heating unit installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant 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 Consultant.

### 3.3 INSTALLATION

- .1 Radiant Heating Installation:
  - .1 Install hydronic radiant heat and cooling tubing loops in accordance with tubing manufacturer's recommendations and as indicated on Contract Drawings. Installation shall follow shop drawings for tube layout, tube spacing, manifold configuration, and manifold location. Comply with notes on shop drawings.

- .2 Manifolds supply and return piping shall be isolated with ball valves.
- .3 Fittings and manifolds shall be accessible for maintenance. The only exceptions are for repair splice with manufacturer's approved fittings and procedure for concealed connections.
- .4 Install tubing loops without splices. It is acceptable to install a repair splice within the embedded loop should on-site damage occur and an emergency repair be authorized. Refer to PEX tubing manufacturer's installation handbook for instructions on the proper installation of the repair splice.
- .5 Ensure that no glues, solvents, sealants, or chemicals come in contact with the tubing without prior permission from the tube manufacturer.
- .6 Manufacturer's bend supports shall be used where tubing enters and exits the slab.
- .7 Methods of tubing attachment shall be to manufacturer's installation handbook.
- .8 Methods of tubing attachment on steel decking: Attach in-floor heating tubing to wire mesh embedded within the concrete topping.
- .9 Pressurize tubing system with air or water in accordance with applicable codes or, in the absence of applicable codes, to a pressure of 60 psi (413 kPa) for 24 hours prior to encasement of tubing system. Tubing shall remain pressurized during encasement and for a period of 24 hours thereafter to ensure system integrity.
- .10 Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Water shall not be used to pressurize the system if ambient air temperature has the possibility of dropping below 32°F (0°C).
- .11 Ensure system is freeze proof should ambient air temperature be anticipated to drop below 32°F (0°C) and the system is not under full operation.
- .12 Initial Balancing: Adjust flow to all loops as indicated on shop drawings. Flow adjustment settings are to be generated by the Uponor Advanced Design Suite software.
- .13 System shall not be operated during panel concrete curing period unless permission has been granted and specific instructions on panel pre-heating has been provided.

### 3.4 CLEANING

- .1 Remove temporary coverings and protection of adjacent work areas.
- .2 Repair or replace damaged installed products.
- .3 Clean installed products in accordance with manufacturer's instructions prior to acceptance.
  - .1 Leave Work area clean at end of each day.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.



3.5 PROTECTION

- .1 Protect installed product and finish surfaces from damage during construction.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.

.2 ASTM International

.1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278/A278M-01(2011), Standard Specification for Grey Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).

.3 ASTM A516/A516M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.

.5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 CSA Group

.1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

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 expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

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 hydronic specialties for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect hydronic specialties from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## Part 2 Products

### 2.1 HYDRONIC EXPANSION TANK (EXP-2)

- .1 Performance: Refer to mechanical equipment schedule.
- .2 Dimensions: Refer to mechanical equipment schedule.
- .3 Shell constructed of ASME approved steel.
- .4 Heavy duty Butyl rubber diaphragm.
- .5 12 PSIG (.8 BAR) factory precharge.
- .6 240 F (116 C) maximum operating temperature.
- .7 125 PSIG (8.6 BAR) maximum working pressure.
- .8 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

### 2.2 AIR SEPARATOR (AS-1)

- .1 Performance: Refer to mechanical equipment schedule.
- .2 Dimensions: 12" D x 22" H.
- .3 Shell constructed from carbon steel.
- .4 Finished in red oxide primer.
- .5 Dirt and Air separator constructed in Accordance with the latest revision of same boiler and pressure vessel code.
- .6 Complete with strainer.
- .7 Stamped for 300 PSI (2100 kPA) working pressure.
- .8 Stamped for maximum operating temperature of 375F (195 C).
- .9 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

### 2.3 CHEMICAL POT FEEDER (CPF-1)

- .1 Performance: Refer to mechanical equipment schedule.
- .2 Dimensions: Refer to mechanical equipment schedule.
- .3 System shall be constructed of carbon steel.

- .4 Valves to be included by manufacturer, constructed of brass.
  - .5 System shall be equipped with 20 US oz. (600mL) polyethylene graduated funnel with integral 20 mesh strainer.
  - .6 Acceptable Product: Refer to mechanical equipment schedule or approved equal.
- 2.4 HYDRONIC SIDESTEAM FILTER (HF-1)
- .1 Performance: Refer to mechanical equipment schedule.
  - .2 Dimensions: Refer to mechanical equipment schedule.
  - .3 System shall include filter, sight flow indicator, ball valve, balancing valve, and nipples.
  - .4 Filter shall be constructed of 304 stainless steel filter housing with 304 stainless steel head and shall include two EPDM o-rings, brass drain valve with barb fitting and cap, and filter cartridge shall be a 25-micron cotton wound filter cartridge with tin core.
  - .5 Sight flow indicator has brass body and shall include EPDM o-rings, two tempered borosilicate glass windows, 304 stainless steel cage, TPX ball, and cork washers (non-wetted part).
  - .6 Ball valve shall be of brass construction.
  - .7 Manual balancing valve shall be of brass construction and comes with an integral air vent, memory stop, and shall be able to provide flow metering, flow balancing, and filter cartridge isolation.
  - .8 Three brass nipples shall each be 75 mm (3") in length.
  - .9 Acceptable Product: Refer to mechanical equipment schedule or approved equal.
- 2.5 HYDRAULIC SEPARATOR (HS-1)
- .1 Performance: Refer to mechanical equipment schedule.
  - .2 Dimensions: Refer to mechanical equipment schedule.
  - .3 System to be constructed of carbon steel.
  - .4 Finished with red oxide primer.
  - .5 System equipped with 304 Stainless steel internal perforated baffles.
  - .6 System to be constructed per ASME Code Section VIII Div. 1.
  - .7 Stamped for 125 PSI (865 kPa) operating pressure.
  - .8 Stamped for 270 F (135 C) operating temperature.
  - .9 System equipped with factory installed blowdown valve and top mounted air vent.
  - .10 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

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 hydronic specialties 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 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 GENERAL

- .1 Run drain lines and blow off connections to terminate above nearest drain.
- .2 Maintain adequate clearance to permit service and maintenance.
- .3 Should deviations beyond allowable clearances arise, request and follow Contract Administrator directive.
- .4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.4 STRAINERS

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump.
- .4 Install ahead of each automatic control valve [and radiation] [larger than NPS 1] [except at radiation]and as indicated.

3.5 AIR VENTS

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.6 EXPANSION TANKS

- .1 Adjust expansion tank pressure to suit design criteria [as indicated].
- .2 Install lockshield type valve at inlet to tank.

3.7 PRESSURE SAFETY RELIEF VALVES

- .1 Run discharge pipe to terminate above nearest drain.

3.8 SUCTION DIFFUSERS

- .1 Install on inlet to pumps having suction size greater than 50mm.

3.9 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 REFERENCE STANDARDS
- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
    - .1 ANSI/ASHRAE/IES Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .2 CSA Group
    - .1 CAN/CSA-B214-12, Installation Code for Hydronic Heating Systems.
  - .3 Electrical Equipment Manufacturers Association of Canada (EEMAC)
  - .4 National Electrical Manufacturers' Association (NEMA)
    - .1 NEMA MG 1-2011, Motors and Generators.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
  - .2 Product Data:
    - .1 Submit manufacturer's instructions, printed product literature and data sheets 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.
    - .2 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.
- 1.3 CLOSEOUT SUBMITTALS
- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00- Closeout Submittals.
- 1.4 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions 01 61 00- Common Product Requirements.
  - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .3 Storage and Handling Requirements:
    - .1 Store materials in dry location off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
    - .2 Store and protect hydronic pumps from nicks, scratches, and blemishes.
    - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MAIN LOOP CIRCULATION PUMP (PU-1 & PU-2)

- .1 Refer to equipment schedules on drawings for performance requirements.
- .2 Casing and cover to be constructed of cast iron to ASTM A48/A48M Class 30A.
- .3 Impeller to be constructed of bronze.
- .4 Shaft to be constructed of carbon steel with bronze shaft .
- .5 Pump stamped to 175 PSIG (1210 kPa) maximum operating pressure.
- .6 Pump stamped to 250 F (125 C) maximum operating temperature.
- .7 Electrical: Refer to Equipment Schedule on Drawing.
- .8 Control: In accordance with Section 23 09 33- Electric and Electronic Control System for HVAC.
- .9 Supports: provide as recommended by manufacturer.
- .10 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

2.2 BOILER PUMPS (PU-3 TO 5)

- .1 Performance: Refer to mechanical equipment schedule.
- .2 Dimensions: Refer to mechanical equipment schedule.
- .3 Casing to be constructed from cast iron.
- .4 Impeller to be non-metallic construction.
- .5 Shaft to be constructed of ceramic.
- .6 O-ring and gaskets to be EPDM.
- .7 Pump to be equipped with integral flow check to prevent gravity and reverse flow.
- .8 Pump to be self-lubricating without mechanical seal.
- .9 Pump stamped to 125 PSIG maximum operating pressure.
- .10 Pump stamped to 230 F maximum operating temperature.
- .11 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

2.3 MANIFOLD PUMPS (PU-6-10)

- .1 Manifold pumps to be included as integral to manifolds and supplied by manifold manufacturer.
- .2 Pump stamped to 145 PSIG maximum operating pressure.
- .3 Pump stamped to 230 F maximum operating temperature.
- .4 Performance: Refer to mechanical equipment schedule.
- .5 Acceptable Product: Refer to mechanical equipment schedule or approved equal.



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 hydronic pump 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 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 INSTALLATION

- .1 Install hydronic pumps to: CAN/CSA-B214.
- .2 In line circulators: install as indicated by flow arrows.
  - .1 Support at inlet and outlet flanges or unions.
  - .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.
  - .3 Check oil level and lubricate. After run-in, tighten glands.
- .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 Pipe drain tapping to floor drain.
- .6 Install volute venting pet cock in accessible location.
- .7 Check rotation prior to start-up.
- .8 Install pressure gauge test cocks.

3.4 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.
- 3.5 PERFORMANCE VERIFICATION (PV)
  - .1 General:
    - .1 Verify performance in accordance with Section 01 91 13- General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
  - .2 Verify that manufacturer's performance curves are accurate.
  - .3 Ensure valves on pump suction and discharge provide tight shut-off.
  - .4 Net Positive Suction Head (NPSH):
    - .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
    - .2 Measure using procedures prescribed in Section 01 91 13- General Commissioning (Cx) Requirements.

- .3 Where procedures do not exist, discontinue PV, report to Contract Administrator and await instructions.
- .5 Multiple Pump Installations - Series and Parallel:
  - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .7 Commissioning Reports: in accordance with Section 01 91 13- General Commissioning (Cx) Requirements reports supplemented as specified herein. Reports to include:
  - .1 Record of points of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
  - .2 Use Report Forms specified in Section 01 91 13- General Commissioning (Cx) Requirements: Report Forms and Schematics.
  - .3 Pump performance curves.
- 3.6 CLEANING
  - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASME
  - .1 ASME B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
  - .2 ASME B16.24, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.
  - .3 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .4 ASME B31.5, Refrigeration Piping and Heat Transfer Components.
- .2 ASTM International
  - .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
  - .2 ASTM B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 CSA Group
  - .1 CSA B52-05(R2009), B52 Package, Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
  - .1 EPS 1/RA/1, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

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 refrigerant piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

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 refrigerant piping for incorporation into manual.
- .3 Submit 3 copies of operation and maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect refrigerant piping, fittings and equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated, and sealed.
  - .1 Hard copper: to ASTM B280, type ACR.
  - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121 degrees C.
- .2 Brazed:
  - .1 Fittings: wrought copper to ASME B16.22.
  - .2 Joints: silver solder, 15% Ag-80% Cu-5%P and non-corrosive flux.
- .3 Flanged:
  - .1 Bronze or brass, to ASME B16.24, Class 150, and Class 300.
  - .2 Gaskets: suitable for service.
  - .3 Bolts, nuts, and washers: to ASTM A307, heavy series.
- .4 Flared:
  - .1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

## 2.4 VALVES

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

## 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 GENERAL

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5, Section 23 05 05 - Installation of Pipework.

### 3.3 BRAZING PROCEDURES

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

### 3.4 PIPING INSTALLATION

- .1 General:
  - .1 Soft annealed copper tubing: bend without crimping or constriction hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Hot gas lines:
  - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
  - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
  - .3 Provide inverted deep trap at top of risers.
  - .4 Provide double risers for compressors having capacity modulation.
    - .1 Large riser: install traps as specified.
    - .2 Small riser: size for 5.1 m<sup>3</sup>/s at minimum load. Connect upstream of traps on large riser.

3.5 PRESSURE AND LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2 MPa and 1 MPa on high and low sides respectively.
- .3 Test procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.6 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
  - .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
  - .1 Twice to 14 Pa absolute and hold for 4 hours.
  - .2 Break vacuum with refrigerant to 14 kPa.
  - .3 Final to 5 Pa absolute and hold for at least 12 hours.
  - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
  - .5 Submit test results to Contract Administrator.
- .7 Charging:
  - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
  - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
  - .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:

- .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
- .2 Record and report measurements to Contract Administrator.
- .9 Manufacturer's Field Services:
  - .1 Have manufacturer of products, supplied under this Section, review Work involved in the 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 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 Twice during progress of Work at 25% and 60% complete.
    - .3 Upon completion of the Work, after cleaning is carried out.
  - .4 Obtain reports, within 3 days of review, and submit, immediately, to Contract Administrator.
- 3.7 DEMONSTRATION
  - .1 Instructions:
    - .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 - Closeout Submittals and CSA B52.
- 3.8 CLEANING
  - .1 Leave Work area clean at end of each day.

END OF SECTION



Part 1            General

1.1            REFERENCES

- .1    American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2    ASTM International
  - .1        ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3    Green Seal Environmental Standards (GS)
  - .1        GS-36, Standard for Adhesives for Commercial Use.
- .4    National Fire Protection Association (NFPA)
  - .1        NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2        NFPA 90B, 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.
  - .2        SMACNA HVAC Air Duct Leakage Test Manual.
  - .3        IAQ Guideline for Occupied Buildings Under Construction.

1.2            ACTION AND INFORMATIONAL SUBMITTALS

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

1.3            DELIVERY, STORAGE AND HANDLING

- .1    Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2    Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3    Storage and Handling Requirements:
  - .1        Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect metal ducts from damage.
  - .3        Replace defective or damaged materials with new.

Part 2           Products

2.1            SEAL CLASSIFICATION

- .1    Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
---------------------	-------------------

500	B
250	B
125	B
125	B

.2 Seal classification:

- .1 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

2.2 SEALANT

.1 Sustainability Characteristics:

- .1 Adhesives and sealants: in accordance with Section 07 92 00 - Joint Sealants.
- .2 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of -30°C to plus 93°C.

2.3 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual and National Energy Code for Buildings.

2.4 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
- .1 Rectangular: standard radius or short radius without 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 with conical connection.
- .3 Provide volume control damper in branch duct near connection to main duct.
- .4 Main duct branches: with splitter damper.
- .5 Transitions:
- .1 Diverging: 20° maximum included angle.
- .2 Converging: 30° maximum included angle.
- .6 Offsets:

- .1 Full radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.
  - .1 Maximum included angles: as for transitions.
- 2.5 FIRE STOPPING
  - .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.
  - .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: SMACNA.
- 2.7 KITCHEN EXHAUST SYSTEMS – DOUBLE WALL GREASE DUCTWORK
  - .1 Intended for use with Type I kitchen hoods. Construct in accordance with NFPA 96.
  - .2 Inner duct section wall shall be constructed of .036" thick, 430 type stainless steel.
  - .3 Outer Duct section wall shall be constructed of 430 stainless steel at a minimum of .024" thickness.
  - .4 Duct shall include 2 layers of Super Wool 607 Plus or Insulfrax Elite Blanket between the inner and outer wall insulation between the inner and outer wall.
  - .5 Duct sections shall be held together by the means of a formed V clamp. V clamps shall be of the hex-head type with flanged stops and tapered "lead in" threads.
  - .6 Duct joints shall be sealed with 3M Fire Barrier 2000+.
  - .7 Duct wall assembly shall be tested and listed at 3/4" or zero inch clearance, according to classifications.
  - .8 Grease filters: to Section 23 38 13 - Commercial Kitchen Hoods.
  - .9 Acceptable product: "CaptiveAire" Factory Built Double Wall Grease Duct Model DW-3Z, or approved equal.
- 2.8 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 mm. Larger ducts to use trapeze hangers.
    - .2 Hanger configuration: to SMACNA.

- .3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA 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 or steel plate washer.
  - .3 For steel beams: manufactured beam clamps

### 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 metal duct installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Contract Administrator.
  - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

#### 3.2 GENERAL

- .1 Do work in accordance SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
  - .1 Insulate strap hangers 100 mm beyond insulated duct.
- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.
- .7 During construction, seal open ends of duct to prevent dust/debris from entering new ductwork.

3.3 KITCHEN EXHAUST SYSTEMS – DOUBLE WALL GREASE DUCTWORK

- .1 Install in accordance with manufacturer's instructions and NFPA 96, or as indicated.
- .2 Provide duct access clean-outs at each change in direction.
- .3 Slope all horizontal exhaust ductwork back towards exhaust hood in accordance with NFPA 96.

3.4 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 (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.5 WATERTIGHT DUCT

- .1 Provide watertight duct for:
  - .1 Fresh air intake.
  - .2 Exhaust discharges
- .2 Form bottom of horizontal duct without longitudinal seams.
  - .1 Solder or weld joints of bottom and side sheets.
  - .2 Seal all other joints with duct sealer.
- .3 Slope horizontal branch ductwork down towards louvers served.
  - .1 Slope header ducts down toward risers.
  - .2 Provide drain piping to floor.

3.6 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA.

3.7 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 Complete test before performance insulation or concealment Work.

3.8 CLEANING

- .1 Leave
- .2 Work area clean at end of each day.
- .3 Upon completion remove surplus materials, rubbish, tools, and equipment.

END OF SECTION

**Part 1** General

**1.1** SUMMARY

.1 Section Includes:

- .1 Materials and installation for duct accessories including flexible connections, access doors, vanes, and collars.

**1.2** REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

**1.3** ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, and data sheet. Indicate the following:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Turning vanes.
    - .4 Instrument test ports.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
  - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports: manufacturer's field reports specified.
- .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**1.4** QUALITY ASSURANCE

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health & Safety Requirements.

**1.5** DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with 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 Store and protect air duct accessories from damage.
  - .3 Replace defective or damaged materials with new.

Part 2 Products

**2.1** GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

**2.2** FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material:
  - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at -40°C to 90°C, density of 1.3 kg/m<sup>2</sup>.

**2.3** ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
  - .1 Up to 300 x 300 mm: two sash locks.
  - .2 301 to 450 mm: four sash locks.
  - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
  - .4 Hold open devices.

**2.4** TURNING VANES

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.



2.5 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

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 data sheet.

3.2 INSTALLATION

- .1 Flexible Connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air units and fans.
    - .2 Inlets and outlets of exhaust and return air fans.
    - .3 As indicated.
  - .2 Length of connection: 100 mm.
  - .3 Minimum distance between metal parts when system in operation: 75 mm.
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 When fan is running:
    - .1 Ducting on sides of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
  - .1 Size:
    - .1 As indicated.
  - .2 Locations:
    - .1 Fire and smoke dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Reheat coils.

- .6 Elsewhere as indicated.
  - .3 Instrument Test Ports:
    - .1 General:
      - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
      - .2 Locate to permit easy manipulation of instruments.
      - .3 Install insulation port extensions as required.
    - .4 Locations:
      - .1 For traverse readings:
        - .1 Ducted inlets to roof and wall exhausters.
        - .2 Inlets and outlets of other fan systems.
        - .3 Main and sub-main ducts.
        - .4 And as indicated.
      - .2 For temperature readings:
        - .1 At outside air intakes.
        - .2 At inlet and outlet of coils.
        - .3 And as indicated.
  - .4 Turning vanes:
    - .1 Install in accordance with recommendations of SMACNA and as indicated.
- 3.3 CLEANING
  - .1 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 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

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 dampers 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 dampers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect dampers from damages.
  - .3 Replace defective or damaged materials with new.

**Part 2** Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon end bearings.

- .5 Channel frame of same material as adjacent duct, complete with angle stop.
- 2.3 MULTI-BLADED DAMPERS
  - .1 Factory manufactured of material compatible with duct.
  - .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
  - .3 Maximum blade height: 100 mm.
  - .4 Bearings: pin in bronze bushings.
  - .5 Linkage: shaft extension with locking quadrant.
  - .6 Channel frame of same material as adjacent duct, complete with angle stop.
- 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 damper installation in accordance with manufacturer's written instructions.
      - .1 Visually inspect substrate in presence of Contract Administrator.
      - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
      - .3 Proceed with installation only after unacceptable conditions have been remedied.
  - 3.2 INSTALLATION
    - .1 Install where indicated.
    - .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
    - .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
    - .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
    - .5 Dampers: vibration free.
    - .6 Ensure damper operators are observable and accessible.
  - 3.3 CLEANING
    - .1 Upon completion remove surplus materials, rubbish, tools, and equipment.

END OF SECTION

- 
- Part 1            General
- 1.1            SUMMARY
- .1        Section Includes:
- .1        Operating dampers for mechanical forced air ventilation and air conditioning systems.
- 1.2            REFERENCES
- .1        American Society for Testing and Materials International (ASTM)
- .1        ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
- .2        Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1        Material Safety Data Sheets (MSDS).
- 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        Indicate the following:
- .1        Performance data.
- .2        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.
- .3        Closeout Submittals
- .1        Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- Part 2            Products
- 2.1            BACK DRAFT DAMPERS
- .1        Automatic gravity operated.
- .2        Frame Material: 18 gauge Galvanized Steel
- .3        Blade Material: Aluminum.
- .4        Bearings: Synthetic
- .5        Maximum Pressure Rating: 2" W.G.
- .6        Maximum Velocity: 2,500 fpm.

- .7 Mounting Orientation: Refer to mechanical drawings for requirements.

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 where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

3.3 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Upon completion remove surplus materials, rubbish, tools, and equipment.

END OF SECTION

**Part 1** General

**1.1** REFERENCES

- .1 National Fire Protection Association (NFPA)
  - .1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S112, Standard Test Method of Fire Test of Fire Damper Assemblies.
  - .2 CAN/ULC-S112.2, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
  - .3 ULC-S505, Standard for Fusible Links for Fire Protection Service.

**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 fire dampers and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate the following:
    - .1 Fire dampers.
    - .2 Fusible links.
    - .3 Design details of break-away joints.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**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 fire dampers for incorporation into manual.

**1.4** MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
  - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

**Part 2** Products

**2.1** COMBINATION FIRE SMOKE DAMPERS

- .1 Dampers shall meet requirements for combination fire smoke dampers in accordance with:

- .1 NFPA 80, 90A, 92, 101 and 105
- .2 National Building Code requirements.
- .3 ULC 555 and 555S
- .4 AMCA
- .2 Provide where shown on the drawings and where required to maintain separations, combination fire/smoke dampers. All damper units to be equipped with linkages for mounting of actuators for smoke control operation, fusible links for fire damper mode and micro switches for status signal (open and closed). Provide all required electric actuators.
- .3 Frame: 16 ga. galvanized steel.
- .4 Blades: 16 ga. Galvanized steel with deep V-gooves.
- .5 Seals and Jamb: Blade seals shall be extruded silicon rubber. Jamb shall be flexible stainless steel compression type.
- .6 Linkage and Axel: linkages shall be non-adjustable and concealed within the jamb of the damper. Axel shall be minimum ½" diameter zinc plated steel.
- .7 Fire Resistive Rating
  - .1 UL 555 fire resistance rating of 1½ hours.
  - .2 UL 555 fire resistance rating of 3 hours.
- .8 Fire Closure Temperature:
  - .1 Each combination fire-smoke damper shall be equipped with a factory installed heat responsive device rated to close the damper when the temperature at the damper reaches:165°F (standard) unless otherwise noted.
- .9 Elevated Operational Temperature:
  - .1 UL 555S elevated temperature rating of 250°F.
- .10 Leakage:
  - .1 UL555S leakage rating of Leakage Class I (8 cfm/ft2 at 4 in. wg.)
- .11 Pressure Differential Rating:
  - .1 Dampers shall have a UL 555S differential pressure rating of 4 in. wg.
- .12 Velocity:
  - .1 Dampers shall have a UL 555S velocity rating of 2,000 fpm.
- .13 Pressure Drop:
  - .1 The damper manufacturer's submittal data shall certify that all pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3, and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal.



- .2 AMCA certified pressure drop for a 24 in. wide x 24 in. high damper shall not exceed 0.09 in. wg when subjected to an airflow velocity of 1500 fpm according to AMCA Test Figure 5.3
- .14 Fire Closure Device:
  - .1 Reusable Resettable Link (RRL) with Open & Closed Indicator (OCI) – an electric heat-responsive device standard on any combination fire-smoke damper that can be reset. OCI shall be linked to the damper blade to indicate whether damper blade is open or closed with remote indicator lights.
- .15 Mounting:
  - .1 Horizontal or vertical to suit application. Refer to mechanical drawings.
- .16 Actuators:
  - .1 Electric, 120V, 2-Position. Coordinate power requirements with Division 26.
  - .2 Mounting Location: Internal or External to suit project requirements.
- .17 Test Switches:
  - .1 Provide test switches for RRL/OCI fire closure device.
- .18 Duct Smoke Detectors:
  - .1 Provided by Division 26. Coordinate with electrical contractor for suitable mounting locations within ductwork.
- .19 Duct Access Doors, retaining angle and Breakaway connections:
  - .1 Field Supplied.
- .20 Sleeves:
  - .1 Damper shall be supplied as a single assembly with a factory installed sleeve made of material matching that of the damper.
- .21 Coordinate electrical requirements with Division 26.
- .22 Acceptable Manufacturers: "Nailor", "Greenheck" or approved equal.

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 fire and smoke damper installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Contract Administrator.
  - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Co-ordinate with installer of fire stopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

3.3 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Upon completion remove surplus materials, rubbish, tools, and equipment.

END OF SECTION

**Part 1** General

**1.1** REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
  - .1 ANSI/AMCA Standard 99-[2010], Standards Handbook.
  - .2 ANSI/AMCA Standard 210-[2007]/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - .3 ANSI/AMCA Standard 300-[2008], Reverberant Room Method for Sound Testing of Fans.
  - .4 ANSI/AMCA Standard 301-[1990], Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

**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 HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Provide:
    - .1 Fan performance curves showing point of operation, kW, W and efficiency.
    - .2 Sound rating data at point of operation.
  - .3 Indicate:
    - .1 Motors, sheaves, bearings, shaft details.
    - .2 Minimum performance achievable with variable speed controllers.

**1.3** MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
  - .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
    - .1 Provide:
      - .1 Matched sets of belts.
      - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
        - .1 Bearings and seals.
        - .2 Addresses of suppliers.

- .3 List of specialized tools necessary for adjusting, repairing or replacing.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions 01 61 00- Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect HVAC fans from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan Construction Waste Management Plan related to Work of this Section.

### 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 in force.
  - .2 Capacity: flow rate, total static pressure, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
  - .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.
  - .4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.
  - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

#### 2.2 FANS GENERAL

- .1 Refer to equipment schedules on drawings for performance requirements.
- .2 Unit shall be fully assembled at the factory.
- .3 Motors:
  - .1 In accordance with Section 23 05 13- Common Motors Requirements for HVAC Equipment supplemented as specified herein.

- .2 For use with variable speed controllers.
  - .3 Sizes as specified.
  - .4 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet outlet safety screens as indicated and as specified in Section 23 05 13- Common Motor Requirements for HVAC Equipment, inlet outlet dampers and vanes and as indicated.
  - .5 Factory primed before assembly in colour standard to manufacturer.
  - .6 Scroll casing drains: as indicated.
  - .7 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
  - .8 Vibration isolation: to Section 23 05 48- Vibration and Seismic Controls for HVAC Piping and Equipment.
  - .9 Flexible connections: to Section 23 33 00- Air Duct Accessories.
- 2.3 KITCHEN EXHAUST FAN (EF-1)
  - .1 Refer to equipment schedule for performance.
  - .2 Direct drive construction.
  - .3 Roof mounted fan.
  - .4 UL705, UL762 and ULC-S645 listed.Variable speed control.
  - .5 Internal wiring.
  - .6 Thermal overload protection (single phase).
  - .7 High heat operation 300°F (149°C).
  - .8 NEMA 3R safety disconnect switch.
  - .9 Exhaust fan with hinged and vented curb assemblies.
    - .1 Curb Dimensions: 26.5" W x 26.5" L x 24.0" H.
    - .2 Curb assemblies complete with 1" R4.3 foil faced fiberglass insulation.
  - .10 Acceptable Product: Refer to mechanical equipment schedule or approved equal.
- 2.4 COOLING EXHAUST FANS (EF-2 & EF-3)
  - .1 Refer to equipment schedule for performance.
  - .2 Direct drive cabinet fan.
  - .3 Galvanized steel housing with duct collars.
  - .4 Centrifugal forward curved wheel.
  - .5 Direct drive EC motor.
  - .6 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

**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 HVAC fans installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Contract Administrator.
  - .2 Inform Consultant 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** FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48- Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00- Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance where required.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

**3.3** ANCHOR BOLTS AND TEMPLATES

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces.

**3.4** CLEANING

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

END OF SECTION

**Part 1** General

**1.1** ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate following:
    - .1 Capacity.
    - .2 Throw and terminal velocity.
    - .3 Noise criteria.
    - .4 Pressure drop.
    - .5 Neck velocity.

**1.2** MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Include:
    - .1 Keys for volume control adjustment.
    - .2 Keys for air flow pattern adjustment.

**1.3** DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect diffuser, registers, and grilles from damages.
  - .3 Replace defective or damaged materials with new.

**Part 2** Products

**2.1** GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity.
- .2 Frames:

- .1 Full perimeter gaskets.
  - .2 Plaster frames where set into plaster or gypsum board.
  - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: as indicated on grille schedule. Confirm all colours with Contract Administrator.
- .5 Acceptable Manufacturer: As indicated on Mechanical Equipment Schedules.
- 2.2 MANUFACTURED UNITS
  - .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.
- 2.3 GRILLE SCHEDULE
  - .1 Refer to Grille Schedule on Mechanical drawings for performance and grille requirements.
- 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 diffuser, register and grille installation in accordance with manufacturer's written instructions.
    - .1 Visually inspect substrate in presence of Contract Administrator.
    - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
    - .3 Proceed with installation only after unacceptable conditions have been remedied.
- 3.2 INSTALLATION
  - .1 Install in accordance with manufacturer's instructions.
- 3.3 CLEANING
  - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment.

END OF SECTION



**Part 1** General

**1.1** SUMMARY

.1 Section Includes:

- .1 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes, and gooseneck hoods.

**1.2** REFERENCES

.1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)

- .1 ANSI/NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

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

- .1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

**1.3** 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.

**1.4** 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 Indicate following:

- .1 Pressure drop.
- .2 Face area.
- .3 Free area.

.2 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.

- 1.5 QUALITY ASSURANCE
  - .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health & Safety Requirements.
- 1.6 DELIVERY, STORAGE, AND HANDLING
  - .1 Packing, shipping, handling, and unloading:
    - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
    - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- Part 2 Products
- 2.1 GOOSENECK HOODS
  - .1 Thickness: to SMACNA.
    - .1 Kitchen: to NFPA 96.
    - .2 Elsewhere: to SMACNA.
  - .2 Fabrication: to SMACNA.
    - .1 Kitchen: to NFPA 96.
    - .2 Elsewhere: to SMACNA.
  - .3 Joints: to SMACNA or proprietary manufactured duct joint as indicated. Proprietary manufactured flanged duct joint considered class A seal.
  - .4 Supports: as indicated.
  - .5 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 12 mm mesh on exhaust and 19 mm mesh on intake.
  - .6 Provide vertical or horizontal backdraft dampers on where noted.
- 2.2 FLASHING
  - .1 Provide flashings to suit installation.
  - .2 Follow detail drawings for vents and pipes penetrating roofs.
- 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 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 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 REFERENCES

.1 Definitions:

- .1 Certified Ratings: catalogued or published ratings obtained from tests carried out by manufacturer or independent testing agency designated by manufacturer and signifying adherence to codes and standards.
- .2 CSA Group
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .4 Underwriter's Laboratories of Canada (ULC)

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 kitchen hood, grease filter, and grease extractor, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba of Canada.
- .2 Indicate the following:
  - .1 Capacity.
  - .2 Pressure drop.
  - .3 Equipment dimensions.
  - .4 Noise rating.
  - .5 Motor size.
  - .6 Connection dimensions.
  - .7 Utility (water, air, fire suppression) connections and sizes.
  - .8 Materials of construction.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

- .1 Store materials off ground, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect metal ducts from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 KITCHEN EXHAUST HOOD (RHD-1)

- .1 Refer to equipment schedules on drawings for performance requirements.
- .2 Type 1 hood, 430 stainless steel construction, stainless steel Captrate Solo filter, UL 710 listed, wall canopy, UL Listed LED recessed round light 3500k warm output.
- .3 Stainless steel supply plenum, air curtain and front supply with perforated grilles.
- .4 Integral wet chemical fire suppression system, piping and controls.
- .5 Integral commercial kitchen controller complete with interlocks for MUA-1 and EF-1.
- .6 Electrical: Refer to equipment schedules on drawings.
- .7 Dimensions: Length 120", Depth 54", Height, 24", Weight 817 lbs.
- .8 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

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 kitchen hood installation in accordance with manufacturer's written instructions.
  - .1 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install hoods in accordance with manufacturer's instructions and NFPA 96.
- .2 Verify size and configuration in the field prior to ordering.
- .3 Install filter/filter media prior to acceptance.

3.3 CLEANING

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

END OF SECTION

**Part 1** General

**1.1** REFERENCE STANDARDS

- .1 American Boiler Manufacturers Association (ABMA)
- .2 ASME
  - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.
- .3 CSA Group
  - .1 CAN1-3.1-77(R2011), Industrial and Commercial Gas-Fired Package Boilers.
  - .2 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.
  - .3 CSA B139-09, Installation Code for Oil Burning Equipment.
  - .4 CSA B140.7-05(R2010), Oil Burning Equipment: Steam and Hot-Water Boilers.
  - .5 CSA B149.1-10, Natural Gas and Propane Installation Code.
  - .6 ANSI Z21.13-10/CSA 4.9-10, Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- .4 Electrical and Electronic Manufacturers Association of Canada (EEMAC)

**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 [heating boilers]and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Indicate on drawings:
    - .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 Burners and controls.
    - .7 All miscellaneous equipment.
    - .8 Flame safety control system.
    - .9 Breeching and stack configuration.
  - .3 Engineering data to include:
    - .1 Boiler efficiency at 25%, 50%, 75%, 100% of design capacity.

- .2 Radiant heat loss at 100% design capacity.
  - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- 1.3 CLOSEOUT SUBMITTALS**
  - .1 Submit in accordance with Section 01 78 00- Closeout Submittal.
  - .2 Operation and Maintenance Data: submit operation and maintenance data for heating boilers for incorporation into manual.
- 1.4 QUALITY ASSURANCE**
  - .1 Regulatory Requirements: work to be performed in compliance with CEAA, CEPA, TDGA and applicable Provincial /Territorial regulations.
- 1.5 MAINTENANCE MATERIAL SUBMITTALS**
  - .1 Extra materials:
    - .1 Submit maintenance materials in accordance with Section 01 78 00- Closeout Submittals.
      - .1 Special tools for burners, access opening, handholes and Operation and Maintenance.
      - .2 Spare parts for 1 year of operation.
      - .3 Spare gaskets.
      - .4 Spare gauge glass inserts.
      - .5 Probes and sealants for electronic indication.
      - .6 Spare burner tips.
      - .7 Spare burner gun.
      - .8 Safety valve test gauge.
- 1.6 DELIVERY, STORAGE AND HANDLING**
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements with manufacturer's written instructions.
  - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .3 Storage and Handling Requirements:
    - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
    - .2 Store and protect boiler and equipment from nicks, scratches, and blemishes.
    - .3 Replace defective or damaged materials with new.

**Part 2** Products

**2.1** DIRECT VENT NATURAL GAS CONDENSING BOILER (B-1, B-2, B-3)

- .1 Refer to equipment schedules on drawings for performance requirements.
- .2 Enclosure material: powder covered galvanized steel.
- .3 Mounting: wall mounted.
- .4 Boiler shall be equipped with a negative venturi.
- .5 Boiler shall be equipped with a natural gas orifice.
- .6 Boiler shall be equipped with an integral exhaust check valve.
- .7 Boiler shall be equipped with a stainless-steel wire mesh burner assembly.
- .8 Boiler shall have a primary stainless steel heat exchanger and a secondary stainless steel heat exchanger.
- .9 Provide with common venting and condensate neutralization kit.
- .10 Electrical: Refer to electrical drawings and Mechanical Equipment Schedules Drawing for reference.
- .11 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

**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 heating boiler 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** MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

**3.3** INSTALLATION

- .1 Install in accordance with ASME Boiler and Pressure Vessels Code, regulations of the Province and Territory having jurisdiction, except where specified otherwise, and manufacturers recommendations.



- .2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.
- .3 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.
- .4 Mount unit level using specified vibration isolation in Section 23 05 48- Vibration and Seismic Controls for HVAC Piping and Equipment.
- .5 Pipe hot water relief valves full size to nearest drain.
- .6 Pipe steam relief valve through roof with drip pan elbow piped to nearest drain.
- .7 Pipe blowdown/drain to blowdown tank/floor drain.
- .8 Natural gas fired installations: in accordance with CSA B149.1.

### **3.4 MOUNTINGS AND ACCESSORIES**

- .1 Safety valves and relief valves:
  - .1 Run separate discharge from each valve.
  - .2 Terminate discharge pipe as indicated.
  - .3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.
- .2 Blowdown valves:
  - .1 Run discharge to terminate as indicated.

### **3.5 FIELD QUALITY CONTROL**

- .1 Commissioning:
  - .1 Manufacturer to:
    - .1 Certify installation.
    - .2 Start up and commission installation.
    - .3 Carry out on-site performance verification tests.
    - .4 Demonstrate operation and maintenance.
  - .2 Provide Contract Administrator at least 24 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.

END OF SECTION

**Part 1** General

1.1 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 84-2013, Method of Testing Air-to-Air Heat/Energy Exchangers (ANSI approved).

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 energy recovery equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Indicate following:
    - .1 Complete fan performance curves for both Supply Air and Exhaust Air.
    - .2 Energy wheel performance data for both summer and winter operation.
    - .3 Motor ratings, electrical characteristics and motor and fan accessories.
    - .4 Combined efficiency data.
    - .5 Material types and gauges of all component pieces and assemblies.
    - .6 Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
    - .7 Estimated gross weight of each installed unit.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test Reports:
  - .1 Catalogued or published ratings: obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
  - .2 Provide confirmation of testing.
- .6 Manufacturers' Instructions: submit manufacturer's installation instructions.
  - .1 Consultant will make available one (1) copy of systems supplier's installation instructions.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

- .1 MERV 8 disposable pleated filters.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment include:
  - .1 Bearings and seals.
  - .2 Addresses of suppliers.
- .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
  - .1 Store materials off ground in dry location indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect energy recovery equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**Part 2** Products

2.1 ENERGY RECOVERY VENTILATOR (ERV-1)

- .1 Refer to equipment schedules on drawings for performance requirements
- .2 General:
  - .1 Packaged Air-to-Air Fixed Plate Energy Recovery Ventilator.
  - .2 The unit must be complete, fully assembled with gauges and controls, ready to be field wired.
- .3 Quality Assurance:
  - .1 Unit must be AHRI 1060 certified.
  - .2 Unit must be tested as per ANSI/UL 1995 and CAN/CSA C22.2.
  - .3 Unit must be ETL certified.
  - .4 Unit insulation shall comply with NFPA 90A requirements for flame spread and smoke generation.
- .4 Cabinet:
  - .1 The cabinet must have a double-wall construction with a 1-inch thick fiberglass insulation.
  - .2 The floor of the unit must be insulated 1 inch with fiberglass and protected with a 22-ga galvanized steel sheet metal.

- .3 Walls must be made of G90 galvanized steel 22 ga.
- .4 The interior wall must be designed to support the structural loads of the cabinet.
- .5 The structural base of the unit must be constructed with 14-gauge galvanized steel.
- .6 The peripheral base must be equipped with lifting lugs.
- .7 The access doors must be equipped with turn handles with integrated locks.
- .8 The access doors must be equipped with hinges.
- .9 The cabinet must allow access to all inside components and allow access for maintenance on one side of the unit; no clearance is needed on the back side.
- .10 Every joint must be sealed with polyurethane-based high strength elastomeric sealant that contains no solvents or isocyanates.
- .5 Fixed Plate Energy Recovery Core:
  - .1 The Energy recovery section must be of the fixed plates air-to-air type.
  - .2 The energy recovery fixed plate core must be made of a cellulose matrix membrane covered with a polymeric layer to recover both sensible and latent energy.
  - .3 The fixed plate air-to-air Heat/Energy recovery core must be easily cleanable.
  - .4 The core efficiency must be rated as per AHRI-1060 and certified by AHRI.
- .6 Fans:
  - .1 The supply and exhaust fan must be double with double inlet forward curve.
  - .2 The bearings must be sealed and permanently lubricated.
  - .3 The fans must be dynamically and statically balanced.
  - .4 The drive assembly must be with pulley and adjustable sheave mounted on an 11-gauge galvanized steel base.
  - .5 The performances of the fans must be tested as per AMCA-210 standard.
- .7 Motors:
  - .1 Motors must have an Open enclosure, Drip Proof high efficiency (EPACT), inverter rated 10:1 with a service factor 1.15.
  - .2 The motors must be mounted on an adjustable base to adjust the fan belt bending and alignment.
  - .3 The fan drive must be by pulley and trapezoidal belt with a fixed pitch driving pulley and a variable pitch driven pulley.
- .8 Filters:
  - .1 Each air circuit must have 2-inches thick pleated and replaceable filters.
  - .2 Filters must be installed ahead the Energy recovery core in both air stream to protect the core against dust and airborne contaminant that may reduce its efficiency.

- .3 Fresh air circuit filters must be MERV8 rated when tested as per ASHRAE 52.2 standard.
- .4 Exhaust air circuit filters must be MERV8 rated when tested as per ASHRAE 52.2 standard.
- .9 Electric preheat Coil:
  - .1 The electrical preheat coil must be installed inside the unit.
  - .2 The electrical preheat coil must be of the Open Element type and be made of galvanized steel.
- .10 Hydronic post-heat coil (HC-1):
  - .1 The hot water post-heat coil must be installed inside the unit.
  - .2 Water coil performances must be tested and certified as per AHRI 410 standard requirements.
- .11 Low Temperature Limit:
  - .1 A temperature sensor monitors the supply air temperature and stops the unit if the temperature drops below an adjustable set point.
- .12 Motorized Damper Fresh Air:
  - .1 Motorized damper on the fresh air duct made of extruded aluminum insulated and activated with an actuator. Dampers must be low leaks and have integrated thermal breaks.
- .13 Motorized Damper Exhaust:
  - .1 Motorized damper on the exhaust air duct made of extruded aluminum insulated and activated with an actuator. Dampers must be low leaks and have integrated thermal breaks.
- .14 VFDs on Motors:
  - .1 Each motor speed must be controlled with variable frequency drive.
  - .2 The drive will be programmed for 3 speeds.
- .15 Electrical:
  - .1 The unit must have a single point power connection.
  - .2 Refer to schedules on drawings for electrical requirements.
- .16 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

**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 energy recovery equipment installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Contract Administrator.
- .2 Inform Consultant 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 Install in accordance with manufacturers recommendations.
- .2 Support independently of adjacent ductwork with flexible connections.
- .3 Install access doors in accordance with Section 23 33 00- Air Duct Accessories for access to coils, dampers and filters.

### 3.3 FIELD QUALITY CONTROL

- .1 Tests:
  - .1 Perform tests in accordance with Section 26 05 00- Common Work Results for Electrical.
  - .2 Include completed Start-Up Checklists as found in manufacturer's IOM.

### 3.4 CLEANING

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

END OF SECTION

**Part 1** General

**1.1** REFERENCES

- .1 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)
  - .1 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size.
  - .2 ANSI/ASHRAE 127, Method of Testing for Rating Computer and Data Processing Room Unitary Air-Conditioners.
- .2 ASTM International
  - .1 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
- .3 CSA International
  - .1 CSA B52, Mechanical Refrigeration Code.
  - .2 CAN/CSA-C656, Performance Standard for Single Package Central Air-Conditioners and Heat Pumps.

**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 energy recovery equipment and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings indicating physical dimensions, performance characteristics and energy savings.
  - .2 Major components and accessories including sound power levels of units.
  - .3 Type of refrigerant used.

**1.3** MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air conditioning components for incorporation into manual.
- .3 Extra Materials:
  - .1 List of specialized tools necessary for adjusting, repairing, or replacing.

**1.4** DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect air conditioning components from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**Part 2** Products

2.1 SPLIT SYSTEM AIR CONDITIONING UNITS (AHU-1 TO AHU-5 & CU-1 TO CU-5)

- .1 Split system air handling unit with condensing unit.
- .2 Provide refrigerant piping between indoor and outdoor unit as per manufacturer recommendations.
- .3 Air Handling Unit (AHU-1 to AHU-5):
  - .1 Performance: Refer to schedules in mechanical drawings for performance requirements.
  - .2 Electrical: Refer to equipment schedule.
  - .3 Steel cabinet construction.
  - .4 1.0" foil faced insulation.
  - .5 Blower housing with controls, motor and blower.
  - .6 Field convertible for vertical, downflow, horizontal left hand or right hand air supply.
  - .7 Coils constructed of aluminum fins bonded to internally grooved aluminum tubing.
  - .8 Copper sweat refrigerant connections.
  - .9 Molded polymer corrosion resistant condensate drain pan.
  - .10 Integrated refrigerant detection system.
  - .11 Acceptable Product: Refer to mechanical equipment schedule or approved equal.
- .4 Condensing Unit (CU-1 to CU-5):
  - .1 Performance: Refer to schedules in mechanical drawings for performance requirements.
  - .2 R-454B Refrigerant.
  - .3 Variable Speed Compressor.
  - .4 Compressor Sound Blanket.
  - .5 Variable Speed Outdoor Fan Motor.
  - .6 Swept Wing Fan Blade.



- .7 Internal Pressure Relief Valve.
- .8 Internal Thermal Overload.
- .9 Composite Basepan.
- .10 Single Row Condenser Coil.
- .11 Powder coated paint.
- .12 Rust resistant screws.
- .13 Integrated refrigerant detection system.
- .14 Electrical: Refer to equipment schedule.
- .15 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

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 energy recovery equipment installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Contract Administrator.
  - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install in accordance with manufacturers recommendations.
- .2 Manufacturer to certify installation.
- .3 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.
- .4 Provide the necessary access space around components to allow for servicing, repair, replacement as well as for the TAB technician to take proper readings. Allow adequate straight duct sections from fan outlets, elbows, or open duct ends to provide accurate duct traverse readings.
- .5 Locate equipment as shown on the drawings to provide best possible connection arrangement and accessibility for servicing. Provide clearances on all sides of equipment as required by Authorities having jurisdiction or Manufacturer, whichever is greater.
- .6 Install and connect remote components such as thermostats, humidistats, control panels, level controllers, etc., that are supplied with the equipment. Install in locations as shown on the drawings and/or as required to make equipment function as required.

3.3 EQUIPMENT PREPARATION

- .1 Provide services of manufacturer's field engineer to set and adjust equipment for operation as specified.

3.4 CLEANING

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

3.5 PROTECTION

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

END OF SECTION

**Part 1 GENERAL****1.1 REFERENCE STANDARDS**

- .1 Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
  - .1 ANSI/AHRI 210/240-[2008], Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
  - .2 AHRI 270-[2015], Sound Rating of Outdoor Unitary Equipment
  - .3 ANSI/AHRI 350-[2015], Sound Performance Rating of Non-ducted Indoor Air-conditioning and Heat Pump Equipment
- .2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
  - .1 ANSI/ASHRAE Standard 15-[2022], Safety Standard for Refrigeration Systems
  - .2 ANSI/ASHRAE 135-[2020], BACnet® - A Data Communication Protocol for Building Automation and Control Networks
- .3 CSA Group (CSA):
  - .1 CSA B52: Mechanical refrigeration code
  - .2 CSA C656: Performance Standard for Split-System and Single-Package Air Conditioners and Heat Pumps

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .4 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .5 Product Data:
  - .1 Thermostat, transformer, controls where integral.
  - .2 kW rating, voltage, phase.
  - .3 All major components and accessories including sound power levels and units.
  - .4 Type of refrigerant used.
- .6 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .7 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.3 MAINTENANCE MATERIAL SUBMITTALS****1.4 CLOSEOUT SUBMITTALS**

- .8 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .9 Operation and maintenance data:
  - .1 Include, in the operation and maintenance manual, manufacturer's maintenance and operating instructions and recommended cleaning materials and methods.
    - .1 Submit maintenance and operating instructions for:
      - .1 ductless split air-source heat pumps.
      - .2 controls.

- .10 Warranty documentation:
  - .1 Submit manufacturer's warranty certificate in accordance with Section 01 78 00 – Closeout Submittals.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- .11 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and:
  - .1 Maintain materials in upright position at all times.

## 1.6 WARRANTY

- .12 Manufacturer's warranty: Manufacturer's warranty document, executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights the Owner may have under the Contract.

## Part 2 PRODUCTS

### 2.1 DUCTLESS SPLIT AIR-SOURCE HEAT PUMPS (HP-1 AND CU-6)

- .13 Performance: Refer to equipment schedules on drawings for performance requirements.
- .14 Provide AHRI Certified products.
- .15 Electrical: Refer to equipment schedules on drawings.
- .16 Multi speed fan: 7 Speeds.
- .17 Refrigerant leak detection.
- .18 Low Ambient Cooling: down to -4°F
- .19 Low Ambient Heating: down to -13°F
- .20 Coil (indoor and outdoor): copper tube / aluminum fin
- .21 Outdoor Fin Coating: Acrylic-Resin/Anti-Corrosive
- .22 Acceptable Products: Refer to mechanical equipment schedule or approved equal.

## 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 energy recovery equipment installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Contract Administrator.
  - .2 Inform Consultant 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

- .23   Install in accordance with manufacturers recommendations.

3.3           FIELD QUALITY CONTROL

- .24   Tests:
  - .1     Perform tests in accordance with Section 26 05 00- Common Work Results for Electrical.
  - .2     Include completed Start-Up Checklists as found in manufacturer's IOM.

3.4           CLEANING

- .25   Upon completion remove surplus materials, rubbish, tools and equipment

3.5           PROTECTION

- .26   Protect installed products and components from damage during construction.
- .27   Repair damage to adjacent materials caused by work of this section.

END OF SECTION

**Part 1** General

**1.1** REFERENCE STANDARDS

- .1 ASTM International
  - .1 ASTM E84-11a, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .2 ASTM C916-1985(R2007), Standard Specification for Adhesives for Duct Thermal Insulation.
  - .3 ASTM C1071-05e1, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-2012, Standard for the Installation of Air Conditioning and Ventilating Systems.
  - .2 NFPA 90B-2012, Standard for the Installation of Warm Air Heating and Air Conditioning Systems (ANSI).
- .3 Underwriters' Laboratories (UL) Inc.
  - .1 UL 2021-1997, Fixed and Location-Dedicated Electric Room Heaters.

**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 unit heaters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence and cleaning procedures.
- .4 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Indicate on drawings:
    - .1 Equipment, capacity, and piping connections.
    - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support sizes and location of mounting bolt holes.

**1.3** CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for unit heaters 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 materials off ground, in dry location, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect unit heaters from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**Part 2** Products

**2.1** HYDRONIC UNIT HEATER (UH-1 & UH-2)

- .1 Refer to equipment schedules on drawings for performance requirements.
- .2 Cabinet:
  - .1 18-gauge steel exterior.
  - .2 Epoxy powder coat finish.
  - .3 Top casing furnished with threaded hanger connections for suspension of unit.
- .3 Coils:
  - .1 Aluminum fins, minimum 0.01" thick.
  - .2 ½" O.D. copper tubing.
- .4 Fans:
  - .1 Propeller type powered by 2-speed PSC motors.
  - .2 Fans equipped with thermal overload protection.
- .5 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

**2.2** NATURAL GAS UNIT HEATER (UH-3)

- .1 Refer to mechanical equipment schedule for performance requirements.
- .2 Natural gas fired, separated combustion unit heater.
- .3 Cabinet:
  - .1 22-gauge aluminized steel casing.
  - .2 Polyester powder coat.
- .4 Heat Exchanger:
  - .1 Aluminized steel construction.

- .2 82% minimum efficiency provided by an indirect-fired tubular heat exchanger with individually fired tubes.
- .5 Integrated automatic pressure switch to prevent burner operation if venting of flue products is restricted.
- .6 Ignition:
  - .1 Integrated control board to control the air mover, inducer, ignition, gas valve, flame sense, and monitor the safety circuit.
  - .2 Direct spark igniter to provide direct ignition of the burners.
- .7 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

**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 unit heaters 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 Install in accordance with manufacturer's instructions.
- .2 Include double swing pipe joints as indicated.
- .3 Check final location with Contract Administrator if different from that indicated prior to installation.
  - .1 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
- .4 Clean finned tubes and comb straight.
- .5 Provide supplementary suspension steel as required.
- .6 Install thermostats in locations indicated.
- .7 Before acceptance, set discharge patterns and fan speeds to suit requirements.

**3.3** 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 unit heaters installation.

END OF SECTION

**Part 1** General

**1.1** REFERENCE STANDARDS

- .1 CSA International
  - .1 CSA C22.2 No. 46, Electric air heaters,

**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 forced air heaters and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence and cleaning procedures.

**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 forced air heaters 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 01 61 00- Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect forced air heaters from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**Part 2** Products

**2.1** ELECTRIC FORCE FLOW HEATER (FF-1 TO FF-3)

- .1 Forced air heaters, commercial type wall mounted as follows:
  - .1 Refer to equipment schedules on drawings for performance requirements.
  - .2 Enclosure:
    - .1 20-gauge steel cabinet, 18-gauge steel grille.

- .2 Epoxy-polyester powdercoat.
- .3 Elements and Fan:
  - .1 Nichrome heating element for instant heat.
  - .2 Closed, permanently lubricated motor.
- .4 Electrical: Refer to equipment schedules on drawings.
- .5 Acceptable Product: Refer to mechanical equipment schedule or approved equal.

**Part 3** Execution

**3.1** INSTALLATION

- .1 Install heaters in accordance with manufacturer's written recommendations.
- .2 Make power and control connections.

**3.2** FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00- Common Work Results for Electrical.

**3.3** CLEANING

- .1 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 forced air heaters installation.

END OF SECTION

Part 1 General

**1.1** REFERENCE STANDARDS

- .1 CSA International
  - .1 CSA C22.2 No.46-M1988(R2006), Electric Air-Heaters.
- .2 Underwriters' Laboratories (UL)
  - .1 UL 1042-2009, Standard for Electric Baseboard Heating Equipment.

**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 convectors and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence and cleaning procedures.

**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 convectors for incorporation into manual.

**1.4** DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect convectors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

Part 2 Products

**2.1** ELECTRIC BASEBOARD HEATER (EBB-1, EBB-2, EBB-3)

- .1 Refer to mechanical equipment schedule on drawings for performance requirements.
- .2 Heaters: to standard CSA C22.2 No.46 , UL 1042;

- .3 Watt density 275 W/ft .
- .4 Heating Element:
  - .1 Stainless steel tubular heating element with aluminum fins.
  - .2 Floating heating element on high temperature nylon bushings reducing expansion noises.
- .5 Cabinet: to CSA C22.2 No.46, UL 1042 pre-drilled back for securing to wall.
  - .1 20-gauge steel connection box.
  - .2 22-gauge steel body.
  - .3 20-gauge steel front panel.
  - .4 Finish: Epoxy/Polyester powder paint.
  - .5 Linear high limit temperature control with automatic reset.
- .6 Relays contactors and transformers temperature controller and power module to switch loads in excess of thermostat rating.
- .7 Electrical: Refer to equipment schedules on drawings.
- .8 Acceptable Products: Refer to mechanical equipment schedules or approved equal.

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 convectors 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 Install baseboard convector heaters, blank sections and controls.
- .2 When wireway is used, remove knock-outs and insert insulating bushing between units.
- .3 Install grounding wire to maintain ground integrity between heating, blank, and auxiliary sections.
- .4 Install thermostats in locations indicated.
- .5 Make power and control connections.

**3.3** FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Ensure heaters and controls operate correctly.

**3.4** CLEANING

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

**3.5** PROTECTION

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

END OF SECTION